consulting engineer

JUL 11
...GINEERING
...LIBR...RY

July 1955

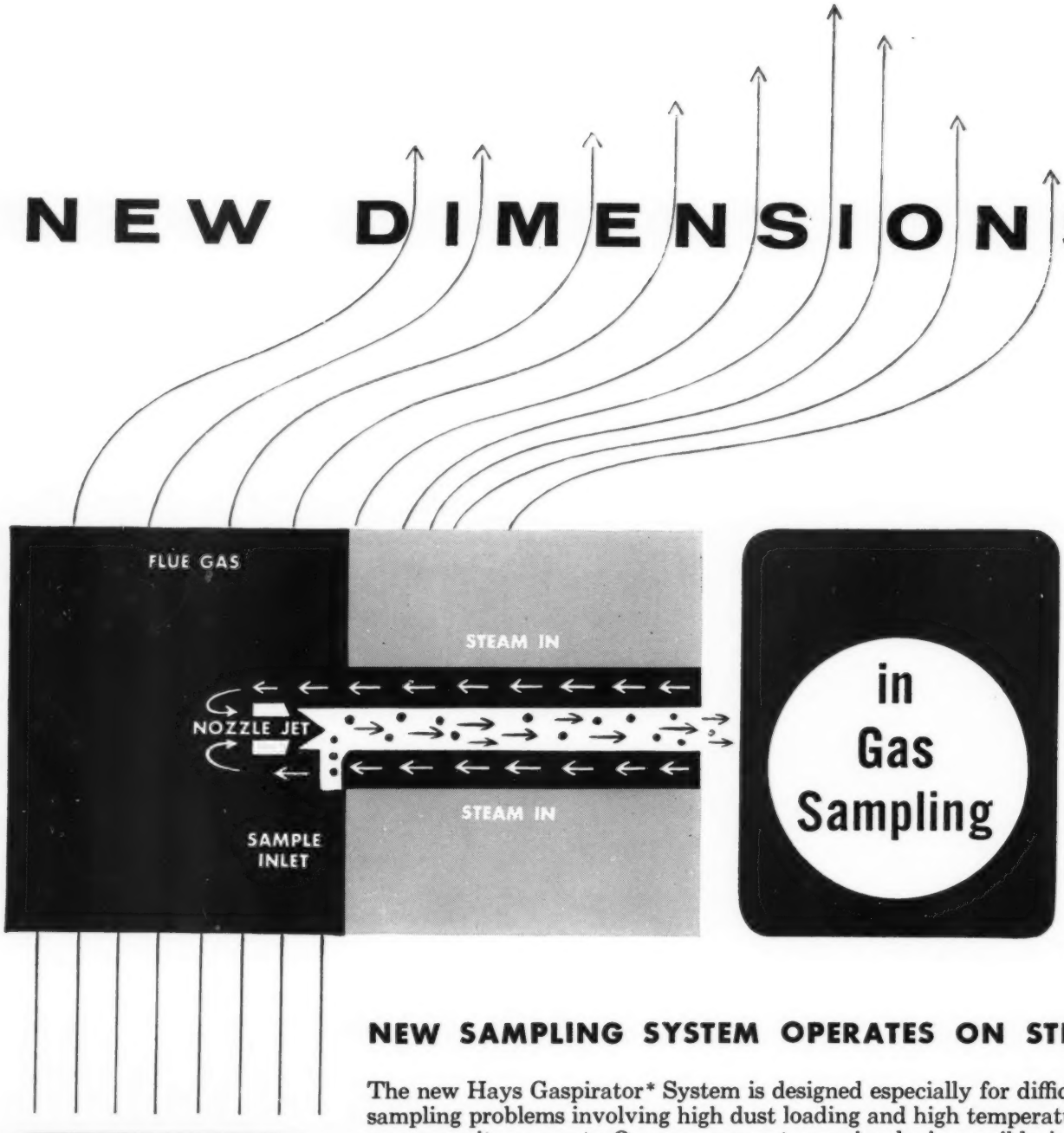
Finding New Ways

RALPH C. ROE, one of the great names in engineering today, has built his organization on a foundation of teamwork and research. His firm, Burns and Roe, Inc., is basically a group of skilled professional men working together. Like any other firm of consulting engineers, their contribution to society consists of the application of their specialized knowledge. Ralph Roe feels that this can

Continued on page 6

The Consulting Engineer's Professional Magazine

NEW DIMENSIONS



NEW SAMPLING SYSTEM OPERATES ON STEAM!

The new Hays Gaspirator* System is designed especially for difficult gas sampling problems involving high dust loading and high temperatures. It now permits accurate O_2 measurement, previously impossible in many applications.

This gas sampling system uses steam to obtain a continuous, clean sample. Suction which is created by the jet nozzle draws the sample in, where it is mixed with the steam. The steam is then condensed. Condensate and entrained solids drop down, and the sample is forced through the analyzer under pressure.

Hays, in the field of gas analysis for more than fifty years, developed the Gaspirator for use with their Magno-Therm Analyzer.

This analyzer, which operates on the paramagnetic principle, has for years been accepted as the leader in the field of O_2 measurement. Hundreds of companies are using the Magno-Therm and Hays electronic recorders very successfully in boiler plants and on process furnaces as a combustion guide, in regeneration of catalysts in refineries and in many other process applications.

For further details write for Bulletin 55-829-56.

*Patents pending.

hays

VOLUME 6

NUMBER 1

Published by Consulting Engineer Publishing Co.
227 Wayne St., St. Joseph, Mich.

consulting engineer®

JULY 1955

FEATURES

36 Profiling the Earth from the Air
W. C. Eddy, Captain, USN (Ret.)

40 Developing Tomorrow's Management for Your Consulting Firm
Florent E. Verdin

43 More Than One Way to Skin a Building
Robert K. Posey

48 Consultants and Atomic Power
Philip D. Bush

53 Ethical Practices
Clement J. Freund

56 Your Stake in Automation
C. E. Evanson

59 Data Handling Systems
S. D. Ross

DEPARTMENTS

Cover Personality—Ralph C. Roe
10 Readers' Comment
14 Scraps & Shavings
20 The Legal Aspect — *Melvin Nord*
16 Report From Istanbul—*Fritz D. Hirschfeld*
26 The Range Finder—*Dr. Gerald J. Matchett*
30 Notes from Abroad
33 Economic News Notes — *E. F. Mac Donald*
34 Atoms in Action
64 News
70 Men in Engineering
74 For Immediate Delivery—Field & Office
76 Booklets
79 Meetings
80 Books
82 Advertisers' Index

Editor, Hunter Hughes
Senior Associate, A. M. Steinmetz
Associate Editor, J. C. Dean
Editorial Assistant, D. L. Wolf
European Editor, F. D. Hirschfeld
Art Director, Jack Knuth
Art Editor, Len Sentowski

Publisher, E. R. Gauley
Production Manager, F. C. Donohue
Sales Manager, O. DeWitt Young
Circulation Manager, Viola Coulombe
Representatives: See addresses p 82
Newark, N. J.; Chicago; Cleveland
Philadelphia; Los Angeles

The Engineering Index Service in Public Libraries lists articles from CONSULTING ENGINEER.

NBP CONSULTING ENGINEER is published monthly at 227 Wayne St., St. Joseph, Mich. Price 1 year $10.00; foreign $15.00; single copy $1.00. Accepted as Controlled Circulation Publication at Saint Joseph, Michigan. Send Form 3579 to Saint Joseph, Mich. Copyright 1955 Consulting Engineer Publishing Co. BPA

Ralph C. Roe

—Starts on front cover

be done best through research and teamwork.

"Following is not good enough," Roe says. "Our firm must lead. We cannot sit back and wait for the results of research to be published in the text books and prove themselves in practice before we investigate. It is the job of the good consulting firm to do its own research.

"Here is an example of what I mean. We have always felt that the consulting firm should do much more than specify standard equipment and supervise its installation. We think the consultants should have a major roll in the development of new designs. The turbine-supporting condenser is the type of thing I have in mind. Several years ago, as result of a discussion with some of the major manufacturers on the possibilities of more economic plant designs, we decided that a more economic design could be produced using the same high quality material but less of it. It also seemed possible to design for the use of substantially less cubage per kilowatt, thereby lowering the initial cost of the plant. As part of this, the turbine supporting condenser was proposed.

We decided that it was up to us rather than to the manufacturers or the utilities to find a new and better approach to the problem. We put our group to work on it. It took us several years and many thousands of dollars out of our own pockets to design the turbine-supporting condenser, but the concept has proved itself in practice.

"We work closely with the manufacturers, of course. Take the installation at the Raritan River Plant of Jersey Central Power and Light, for example. Here we developed a design for an 80,000-sq ft Westinghouse, radial flow condenser that supports a 125,000-kw General Electric turbine generator weighing 1,252,130 pounds. We all had to work together, but we think it should be up to the consulting engineers to do more of the basic design and research, as we did in this instance.

"As developer of original designs and methods, the consultant is in an unique position. Where the client wishes and conditions warrant, designs can be made which are old in the art, and the client can be fully appraised of the status and desirability of that type of design for his particular situation as compared with the newer concepts. On the other extreme, designs can be made as advanced as the art and safety to capital investment permit — with the resulting lower obsolescence and higher efficiency. Between these two extremes any justified variation can be made to suit particular conditions. Never will our firm promote any design without fully informing the client of the state of the art and the relation of that design to the current state of engineering knowledge in the field. No new design will be offered to the client until we are satisfied it is sound, workable, and practical; after which it must also be economically justified. We are very careful about that. Burns and Roe always puts in the time necessary on every new development — and we carry the cost of development ourselves. The salaries of the engineers and the cost of the materials come from our funds.

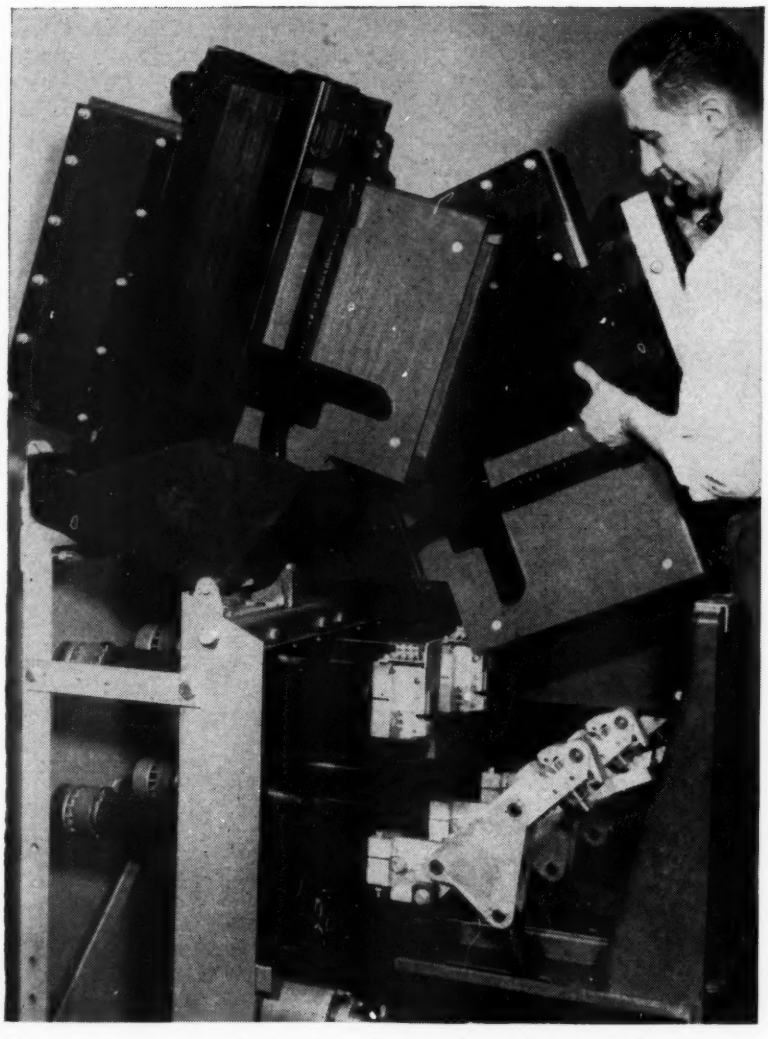
"For the past seven years we have been doing a great deal of investigation and work on the old idea of combining gas turbines with a steam plant for the benefit of both. This work has involved the use of pressurized boilers and also some combinations without the boiler being pressurized. Several years ago, we published an article on the economics of this combination and since then have done a vast amount of work on it both by ourselves and with some of the major manufactors. Today, where conditions are suitable, such plants are believed to be economically feasible and sound from an engineering viewpoint, providing a significant and major improvement in the thermal efficiency of a power plant.

"At the moment we are most interested in finding means for improving regenerative cycles—in developing regenerative cycles of unique design.

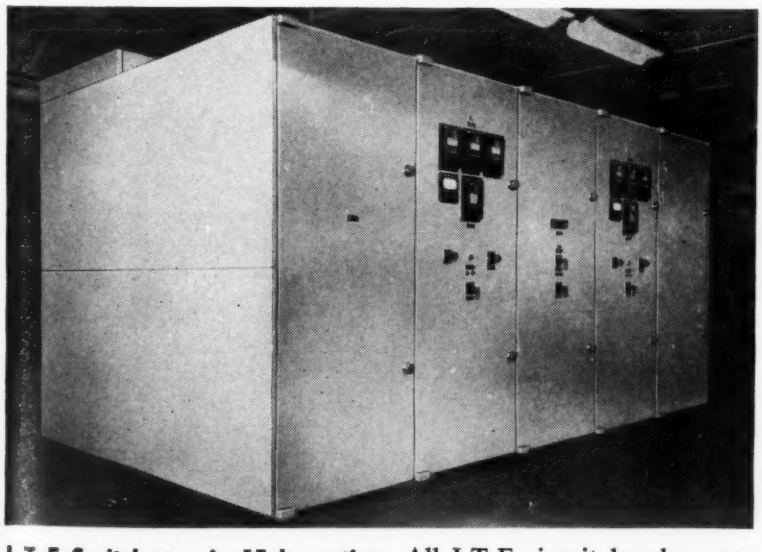
"Atomic reaction is, without question, the coming source of heat for generation of electric energy. We must not forget, however, that heat source is not all there is to a power plant. Engineers must still work for the improvement of the whole cycle, and we intend to continue to study the possibilities for improvement of the cycle as a whole.

"We feel fortunate in having the contract as agent constructor for the Shippingport plant of Duquesne Light Company. This is pioneer work. We hope to learn much about atomic power plants from this job. The industry as a whole will gain invaluable knowledge from the construction and operation of the project and will owe a great debt of gratitude to the U. S. Atomic Energy Commission and the Duquesne Light Company for undertaking the first large scale atomic power plant. This experience will also be important in our work on conventional steam plants to be built in the coming decade. Every new project contributes to the background and ability of our engineering team. Already on this job we have learned a few things that will stand us well in any power projects in the future, atomic or otherwise.

"We have only been in business twenty years, starting with three officers and two employees. Twenty years is not a long time, but it has been a period of engineering progress unequaled in history. We feel fortunate to have been a part of this age. We look forward to even more startling developments in the twenty years ahead, and we intend to be in on them. And we intend to be contributors to knowledge as well as appliers of knowledge in this age ahead. We will do our part of the research. Our men will use their minds to find new ways as well as to make use of methods discovered by others. ▲▲



No cranes are required. Arc chutes pivot. Rest on fixed stop. Illustration shows 15 kv magnetic air circuit breaker.



I-T-E Switchgear in 15 kv rating. All I-T-E circuit breakers are horizontal drawout, interchangeable in like ratings.

TILTING ARC CHUTES

New I-T-E development for 15 kv air circuit breakers

The saving of time and effort which the new I-T-E tilting arc chutes make possible can best be appreciated by anybody who has ever removed the other kind. When inspection time comes, there's no crane lifting of heavy assemblies, no danger of dropping and damaging valuable parts. The arc chutes pivot back safely out of the way for easy inspection of contacts and arc plates. Only I-T-E makes magnetic air circuit breakers with this convenient, modern feature.

I-T-E Metal-Clad Switchgear is made in three basic ratings (5 kv, 7.5 kv and 15 kv), and will interrupt through 500,000 kva. Throughout the line, time-proved features add extra value. Circuit breakers are jig fitted to enclosures. Welded, rigid frames and housings can be lifted as a unit without losing alignment. Complete isolation of compartments insures safety and continuity of service.

Take advantage of I-T-E planning and engineering assistance when you order switchgear. It assures you protection with economy, plus better performance. For details, contact the I-T-E field office nearest you—look in your classified directory under "Electric Equipment." Or write for Bulletin 7004C. I-T-E Circuit Breaker Company, Switchgear Division, 19th & Hamilton Sts., Phila. 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY Switchgear Division

READERS' COMMENT

An Engineer in Four Years

Sir:

I was very much interested in your "Scraps and Shavings" article on page 18 of May 1955 issue of CONSULTING ENGINEER. I was particularly interested in your last paragraph.

I believe it was in 1939 that D. B. Steinman took the same attitude to the American Society for Engineering Education. A committee was appointed to make a study and reported in 1940. It came to the conclusion that four years was the right time for the B.S. in Engineering. Another study was made in 1944 in an effort to anticipate possible changes for students who were coming back from military service. Again the Committee came up with the four year program.

This June a three-year study of the engineering program will be completed and again the Committee is favorable to the four years rather than the six which you suggest. The reason is twofold: first, there is no way to give an engineer all the subject matter he needs to know in a four-year, five-year, six- or seven-year period. He must continue to be a student all his professional career. Second is that a fifth and sixth year can be better used in graduate study. Certain fields of design, research, and development need six or seven years of preparation before entering into the profession. The educators are trying to find some kind of balance between the undergraduate needs and preparation for needed graduate study.

N. W. Dougherty
Dean of Engineering
The University of Tennessee
Knoxville, Tenn.

Registration Standards

Sir:

Mr. Alan G. Stanford, (cover personality, April '55) says he is in favor of the corporation practice of engineering. He ignores the varying state standards for registration of professional engineers.

Assume an engineering corporation has a job in State A which has high standards for professional engineers. The corporation's assistant in direct charge of the job, who is a professional engineer in State A, has to report to the president in State B which has low professional standards for engineers. The corporation's president is not able to obtain a license as a professional engineer in State A. So we have the president in State B with low qualifying standards dictating to an assistant in State A with high qualifying standards. The assistant who may have strong reservations on instructions issued either does as he is told or loses his job.

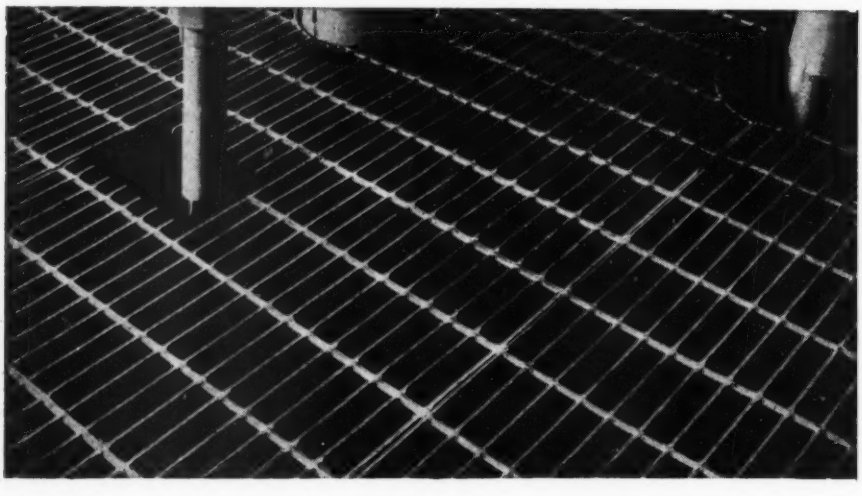
Gregory M. Dexter
Consulting Engineer
Scarsdale, N. Y.

Dollar Credits — Not Cash

Sir:

The interesting article in your May issue on Mr. Kuljian is disconcerting, in that part is based on the widespread notion that we can give dollars away to a foreign country in the form of cash. We have generously given away many billions of dollars to foreign countries, not in the form of bales of bills or sacks of silver, but as dollar credits, ultimately redeemable only in the U.S. A. for U.S. goods or U.S. services.

Possibly the only way to give cash away to another country that did not use the same currency (hence not a foreign country), and not have it come back to the donor country to establish a credit for a corresponding amount of the goods or the services of the donor, would be to send it in the form of gold coins which could be melted and reissued



Gary

WELDED GRATING

Tailor Made to Your Specs

Save installation time and money by having Gary factory-fabricate your open steel flooring needs. For complete description of Gary Gratings, write for Catalog No. CE-75.

FREE SAMPLE
We'll send this handy paper weight if you request it on your company stationery.

Standard Steel Spring Division
ROCKWELL SPRING AND AXLE CO.
4015 East Seventh Avenue • Gary, Indiana

INSULATED METAL WALLS

for INDUSTRIAL and COMMERCIAL BUILDINGS

ALUMINUM, STAINLESS or GALVANIZED STEEL

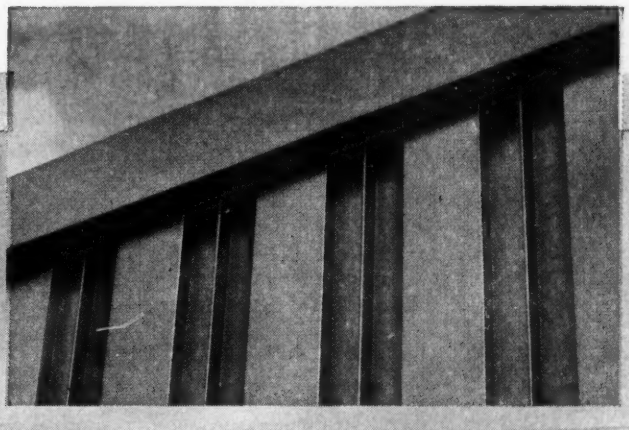
FLUSH, RIBBED, or FLUTED
Over-all "U" Factor of Various Types is Equivalent to or Better than Conventional 16" Masonry Wall

From Maine to California, and from the far north in Canada to Mexico, you'll find new, modern industrial and commercial buildings sporting bright, attractive exteriors of Mahon Aluminum or Stainless Steel Curtain Walls. In a few short years, the trend has swung definitely to this economical, light weight curtain wall construction . . . one large manufacturer has built seven complete new plants—including powerhouses—with Mahon Insulated Metal Walls. Several others have built two or more plants employing the same construction. In the Public Service Field, thirty-five power and steam generating plants have been built with Mahon Insulated Metal Walls. This is truly nationwide acceptance. Every day, more and more architects are giving their clients the benefit of this modern wall construction. Before you plan your next building, investigate the savings in material and labor costs, and the cumulative savings deriving from reduced construction time, which is always a plus factor when buildings are enclosed with quickly erected insulated metal curtain walls. Mahon Insulated Metal Walls can be erected up to sixty feet in height without a horizontal joint—a feature of Mahon Walls which is extremely important in powerhouses, auditoriums and many other types of buildings where high expanses of unbroken wall surface are common. See Sweet's Files, or write for Catalog B-55-B.

THE R. C. MAHON COMPANY

Detroit 34, Mich. • Chicago 4, Ill. • Representatives in All Principal Cities

Manufacturers of Installed Metal Walls and Wall Panels; Steel Deck for Roofs and Partitions Permanent Floor Forms; Electrified Cel-Beam Floor Systems; Rolling Steel Doors, Grilles and Underwriters' Labeled Automatic Rolling Steel Fire Doors and Fire Shutters.

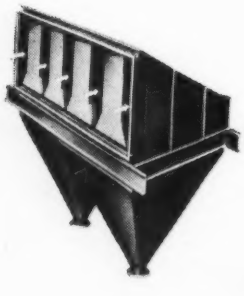


MAHON

Your plant and equipment suffers . . . your community goodwill fades away. These problems can be solved. Prat-Daniel Collectors are designed for the control of industrial dusts and flyash. Multiple small diameter tubes provide powerful centrifugal forces, resulting in sustained high collection efficiency . . . even with ultra-fine dusts.

Whether the problem is industrial dust or flyash, you are assured of satisfaction with P-D Collector Systems, engineered to meet your specific needs.

Write for Reprint No. 102 titled, "What Type Collector?"



pd

Project Engineers
THE THERMIX CORPORATION
GREENWICH, CONN.
(Offices in 38 Principal Cities)
Canadian Affiliates: T. C. CHOWN, LTD., Montreal 25, Que.; Toronto 5, Ont.

Designers and Manufacturers
PRAT-DANIEL CORPORATION
SOUTH NORWALK, CONN.
POWER DIVISION: Tubular Dust Collectors, Forced Draft Fans, Air Preheaters, Induced Draft Fans, Fan Stacks

in the form of the recipient country's own currency.

Thus, we don't need to ask embarrassingly that half the money we give as aid be spent to buy the needed equipment from us, when every single nickel of it comes back anyway sooner or later, to buy our equipment, materials, products, food, professional services, or labor.

James d'A.Clark
Research and Development Engineer
Longview, Wash.

We Presumed Too Much

Sir:

It has been called to my attention that on page 72 of the May 1955 issue of CONSULTING ENGINEER you carried a short item accrediting the H. K. Ferguson Company as designers and constructors of the Company's (Western Electric) new Long Island Distributing House now under construction in Queens, N.Y.

Unfortunately, you have been furnished with incorrect information. The Lockwood Greene Engineers, Inc., of New York, in conjunction with Western Electric Company engineers, designed the new Distributing House. The H. K. Ferguson Company was awarded the contract for the construction of this reinforced concrete structure . . . . .

J. Clifford Johnson
Information Supervisor
Western Electric Co., Inc.
New York, N.Y.

• INFORMATION FURNISHED WAS CORRECT. WE PRESUMED TOO MUCH.

Glad To Have You Aboard

Sir:

Having seen several issues of your CONSULTING ENGINEER Magazine I find that it is something that would be most interesting and valuable to me. I would appreciate your putting me on the mailing list. For your information I will take office as State President of the Nebraska Society of Professional Engineers June 1st.

Raymond H. Reed
Raymond H. Reed & Co.
Columbus, Nebraska

Sir:

I have found CONSULTING ENGINEER both informative and interesting, and with your kind permission I would like to be included on your mailing list to receive the regular monthly issues.

George E. Sanctorum
Mechanical Engineer
Leinweber, Yamasaki & Hellmuth
Detroit, Michigan

good boiler insurance!"

YARWAY WATER GAGES

Flat glass, high pressure type shown. Features new separated-design insert and Type "M" illumination that causes water level meniscus to "shine like a star". Described in Yarway Bulletin WG-1815.

YARWAY REMOTE SIGNAL ALARMS

Lights on horns, operated by Control Unit on Yarway Indicator, give instant warning of any serious deviation from normal water level. Can be located anywhere in plant. Described in Yarway Bulletin WG-1824.

YARWAY HI-LO-GRAPH RECORDER

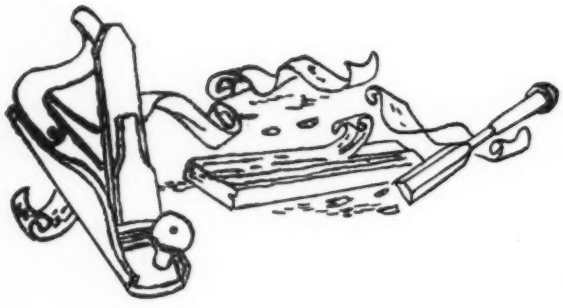
Gives a continuous 24-hour record of liquid levels. Actuating mechanism is same as in Yarway Indicator. Used both for indicating and recording. Described in Yarway Bulletin WG-1830.

YARWAY TELEVISION

Simplified system consists of compact camera and panel-mounted monitor. Clear, bright image of water level gage anywhere in the plant. Described in Yarway Bulletin WG-1813.

steam plant equipment

BLOW-OFF VALVES
WATER COLUMNS AND GAGES
LIQUID LEVEL INDICATORS
EXPANSION JOINTS
STEAM TRAPS
STRAINERS
SPRAY NOZZLES
DIGESTER VALVES



SCRAPS & SHAVINGS

JUST A FEW DAYS AGO, we spent the evening with a distinguished consulting engineer who has been practicing for almost 50 years. While we were impressed with his intellect and his proper pride of accomplishment, we were most attracted by his clear understanding of the present.

He told us about his early years as an engineer. His life was not at all the life ahead of the young engineer leaving school today. He was single and had no family responsibilities. He was from a well-to-do family, as were almost all of his fellow students in college. He revered his degree in engineering, for there were not many granted at that time. He knew, however, that his degree did not make him an engineer; that was to come through accomplishment, and he was prepared to intern himself for several years before beginning his career.

Six years after graduation he married. He had a job with a good future, a job in the specialized field of work he had chosen after he had studied his engineering interests. During these early years of marriage he lived in a large and comfortable home. His wife's widowed aunt lived with them, and they had two servants in the house and a gardener half of each day. They managed this, without too much trouble, out of his income earned as a junior engineer in a consulting firm.

This young engineer worked without any regard to time. He was able to work by the project rather than by the hour or day. If he wanted to get to work early, he could be sure the cook would give him breakfast at any hour he called. If he would work late, his family was not inconvenienced nor were home chores neglected. If the house needed painting, a painter was hired. If the basement flooded, they called a plumber. If the floors needed refinishing, a carpenter came by. Baby-sitters were no problem, for the aunt was always at home.

It was easy to find the time to be an engineer—to work on the job by which he was earning his living. He had few outside demands on his time.

As our evening together went on, I half expected this elderly gentleman to offer his way of life as the proper way for the young engineer today. He knew better than that.

He knew that there is not room in the small house for the widowed aunt and that two servants and a part-time gardener are out of the question for the young family. This lack of help has been offset for the wife by manufacturers of household appliances who have concentrated on changing housework to "homemaking." They have at least partially replaced the missing servants with electricity. The wife, if she misses the companionship and help of the widowed aunt, has the compensation of an electric kitchen and a washing machine.

The husband has no such compensation. The simplified methods and the modern equipment have put him to work at home rather than relieved him of chores. The powered lawnmower, the power saw, the electric hedge clippers and all of the "do-it-yourself" equipment have not made it easier for the husband but harder. The consultant who charges his clients $150 per diem goes home at the end of the day and is called on to cut the grass for four hours (valuation $75.00) because "gardeners are too expensive" and "it's silly to hire someone when you have the big power mower." Then, when the attic needs insulating, this same engineer spends Saturday and Sunday ($300) putting in the Fiberglas himself, because it is so easy "it would be foolish to hire men at what they are charging these days."

The result is that the young married engineer is spending eight hours working at engineering and another four hours a day as a gardener, carpenter, plumber, or electrician. This just does not make sense. "Do-it-yourself" is a money-saver only for the man whose time is worth less than that of a yardman or a man-of-all-work.

For the man on a salary, the temptation is great to say to himself, "When I work longer at the office, I still get the same pay. If I put in that extra time at home, I save the labor costs."

"That," said our elderly engineer, "is where he is wrong." "If a man is worth five dollars a working day or five hundred, that is the value, too, of his evenings and his week-ends. The way he spends that time will not show up in the next pay-check, but it will show up in his next raise or his next job."

We think that is good advice. We agree with him.

(The wife just called and said to bring home a loaf of bread, two quarts of milk, and a pound of bacon. She also reminded us of the gallon of white gas we will need for the mower. What can you do?) ▲▲

REMOTE DIALED WEIGHT SELECTION BELONGS IN YOUR BUSINESS

THIS NEW FREE BOOK TELLS THE FULL STORY OF

RICHARDSON SELECT-O-WEIGH®

REMOTE WEIGHT SETTING SYSTEMS

Here are answers to the puzzlers you've had about completely automatic weighing, proportioning and blending. Richardson's new 28-page booklet shows in detail how industries like yours use Select-O-Weigh systems to "dial" as many as 20 individual ingredient weights in formulas.

Many industrial "case histories" and over fifty easy-to-understand diagrams and illustrations take you through Richardson's material-saving, time-saving, labor-saving story of finger-tip formulation which requires no manual changes, even for fractional proportions. Send for this free booklet today. See how a Select-O-Weigh system—developed out of Richardson's 50 years of experience in building automatic weighing, proportioning and blending equipment—can solve countless problems in your change-over from conventional weighing and proportioning methods to automation.

Write today for your free copy of Bulletin 0351.

Richardson
MATERIALS HANDLING BY WEIGHT SINCE 1902

RICHARDSON SCALE COMPANY
Clifton, New Jersey

Atlanta • Boston • Buffalo • Chicago • Cincinnati • Detroit
Houston • Memphis • Minneapolis • New York • Omaha
Philadelphia • Pittsburgh • San Francisco • Wichita • Montreal
Toronto • Havana • Mexico City • San Juan

1448

REPORT FROM ISTANBUL

FRITZ D. HIRSCHFELD
European Editor

BECAUSE OF ITS natural deep-water port and strategic location on the Bosporus between the Black Sea and the Mediterranean, Istanbul has been a center of commerce and finance since its earliest times. Impressive mosques, palaces, aqueducts, and crumbling fortresses testify to the achievements of past civilizations. Today, Turkey is striving to regenerate some of its former wealth and position by becoming an industrial nation.

In the provinces, the efforts are directed towards making use of the country's natural resources. Most of the necessary engineering and management comes from the capitol, Ankara. Istanbul's role in this development seems to be to support these activities through its financial, commercial, and educational facilities, which are the best in Turkey.

The necessary institutions to support these developments are there, and most of them have been in business a long time. But one senses a lack of aggressiveness in the attitude of the responsible officials. The gist of my conversations with some of the Turkish businessmen in Istanbul is enlightening. It can be summed up in this typical give-and-take:

How do you propose to go about modernizing your country during the years ahead?

Well, basically we think that private investments are the answer. While we appreciate American dollar aid, we would much prefer to see more American private capital invested in developing our country.

What have you done to sell American investors on the opportunities in Turkey?

It's true that there's lots of competition for the investment dollar, but we think we've taken a big stride by passing a favorable Foreign Investment Encouragement Law.

Is this the extent of your sales effort?

Why, what do you mean?

Clarence Randall was over here about two years ago and told Turkish government officials and businessmen that it wasn't enough to simply pass a favorable investment law. A positive and aggressive sales effort was equally necessary.

We agree with Mr. Randall's thinking that this promotional activity is necessary, but we don't have the money to sponsor such a program.

Take the Dutch for example. They established intelligent and experienced representatives in the U.S. to encourage American investments in Holland.

Perhaps later on, when we are in a better position, we may consider a similar project. However, you must remember that we have had no experience with that type of selling or sales promotion. Our own people must first be convinced and thoroughly conscious of the problems involved in attracting private investment capital before we can successfully tackle such a program.

The Istanbul-Hilton

Conrad Hilton and his new Istanbul-Hilton is probably the most outstanding example of American enterprise in Turkey. Mr. Hilton and his organization conceived the idea of an ultra-modern hotel in Istanbul and successfully talked private Turkish interests into providing the money to build it. The FOA granted the necessary dollars to pay for the American design and engineering work, and Hilton received a 20 year lease to operate the hotel after its completion this summer.

The finishing touches to the hotel were being made during my visit, but it hasn't opened for business yet. They tell me that the hotel is practically booked solid for a year in advance. And why not! For those Americans who have traveled in the Middle East and have put up with standard Middle East plumbing, the new Hilton will prove an oasis.

There are about 500 rooms, all with outside exposures, picture windows, and balconies. The public rooms are air-conditioned. There is a swimming pool and a number of fountains. Bars, cafeteria and restaurant space, complete laundering and dry-cleaning, come under the heading of service. A central heating system is an integral part of the hotel. There is a standby diesel generator for emergency power. From foam rubber mattresses to interior decorating, nothing has been spared to make this one of the most plush and extravagant of the Hilton chain of hotels.

George O'Mara, the very capable resident engineer for Skidmore, Owings and Merrill, is the only representative of an American consulting engineering firm that I met in Istanbul. George came over here some three years ago with a set of architectural

INDUSTRIES THAT MAKE AMERICA GREAT

CHEMICALS...HARD AT WORK WHEREVER YOU LOOK

Plastics, fertilizers, gasoline additives, paints, insecticides, synthetic fibers, medicinals—each a giant in its own right—are but segments of this nation's huge, complex chemical industry. It is a field so vast, with derivative products reaching into the farthest corners of daily life, that it is difficult to visualize the full scope of its contributions to our health, comfort and pleasure—to the overall progress of America.

Research is the keystone of the arch called chemical progress. Recognizing and acting on this fact, the industry budgets some $300 million annually for research while employing 10% of all research personnel in the country. It is this wise application of its own men, its own time, and its own money to research that has enabled the chemical industry to achieve its remarkable growth.

In this history of chemical research, development and growth, one other important contributor is steam. Without steam—and its teammate power—many of the accomplishments of this vital industry would have been more difficult, impractical, or perhaps impossible to attain.

B&W, through its own intensive program of research and engineering development, and its boiler-building experience spanning almost a century, has made valuable contributions to the science of steam generation for processing, power and heat. And these in turn, applied within the chemical industry, have helped chemistry make progress run a little faster for all America. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

BABCOCK & WILCOX
BOILER DIVISION
N-199

and engineering plans and specifications drawn up in the New York offices of his firm. Working with a German contractor, Turkish labor, answering to Turkish owners as well as American interests, and using equipment from European and American manufacturers resulted in many headaches. But the fact that the hotel was successfully promoted and has now been completed stands to the credit of those involved.

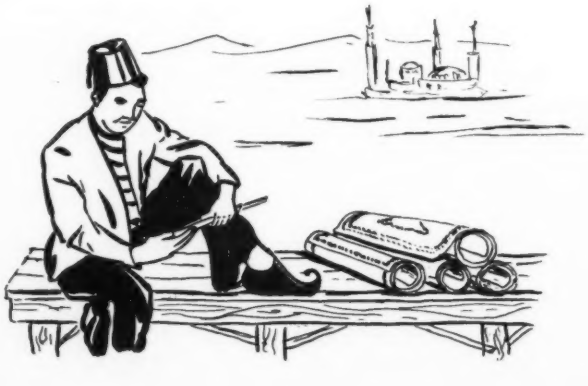
Besides representing another step in Turkey's modernization scheme, the Istanbul Hilton will materially help the country. The hotel will attract American visitors and bring needed American dollars to Turkey. It will undoubtedly encourage the building of other new hotels and force the old ones to improve their facilities and standards of service. As a tangible example of American enterprise, it may stimulate a little more aggressiveness among members of the Turkish business community.

Engineering Education

One fellow who is pretty well in step with the times is Dean Mustafa Santur, of the Istanbul Technical University. U.S.-educated Dean Santur takes the position that the role of the University is not only to turn out engineering graduates but also to work hand-in-hand with industry and to assist in industrial development. The professors are encouraged to gain industrial experience and to take on consulting assignments. By maintaining an up-to-date and well-equipped laboratory, the University is able to run soil tests and analyses, standard strength tests on metals, and other tests useful to construction and industry. Previously, because of the lack of facilities in Turkey, these tests had to be conducted abroad in foreign laboratories.

When I visited the hydraulic laboratories I saw a German engineer, who was on loan to the University, supervising the construction of scale models to represent some of the dams presently underway in Turkey. The experiments carried out with these scale models will provide important information for the engineers and contractors on the actual job site. It also gives the student engineers a practical background to supplement their theoretical engineering training.

By making the University of direct value to industry, Dean Santur hopes to encourage grants from private sources which will make the school less dependent on government aid and will allow them to expand their laboratories and staff as required.



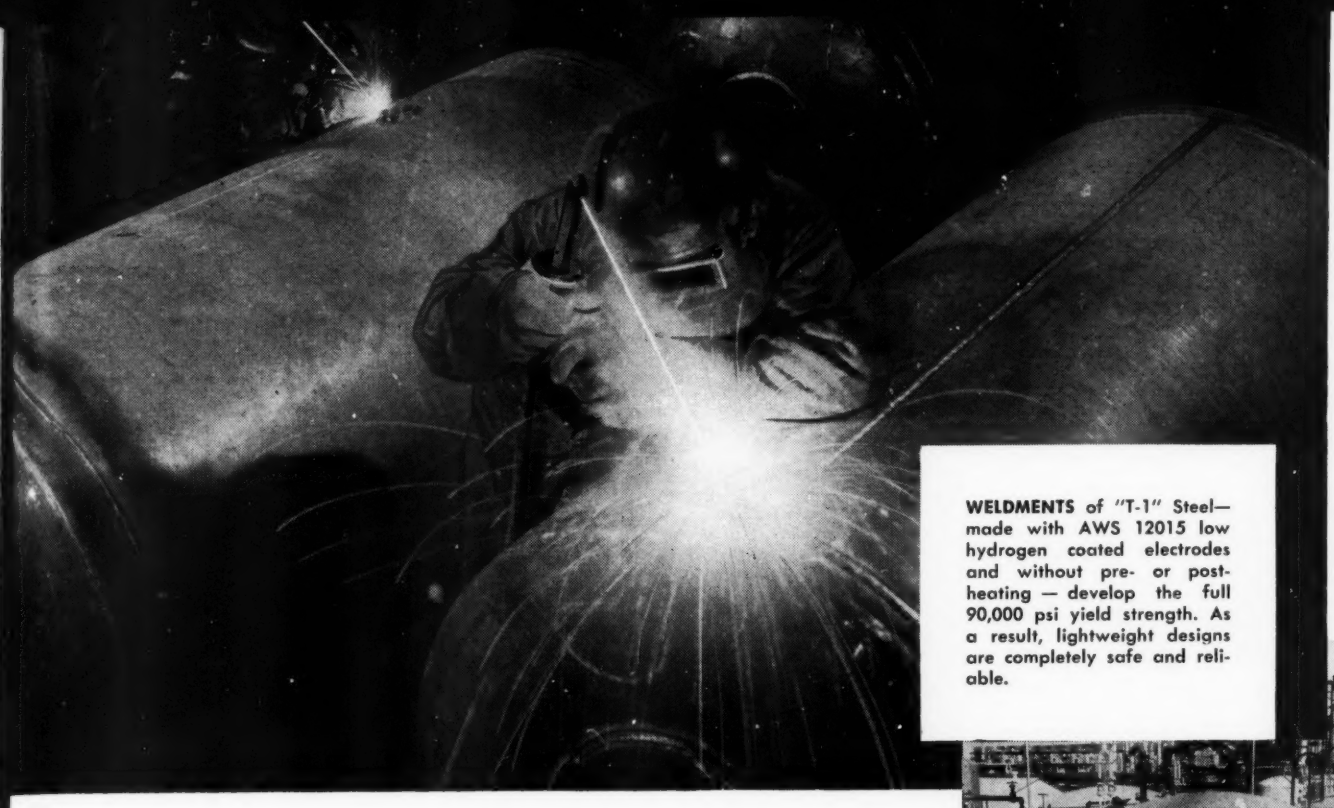
On the other hand, it appears that Robert College, the American-endowed school founded over 50 years ago to help train Turkish engineers, has fallen behind. It's still training engineers, but it evinces little active interest in the important developments going on in the country today. The excuse is that there is no money for equipment or staff. But the problem goes deeper than that. More likely, rigid policies based on by-gone days and conditions have caused the deterioration. I understand that there are going to be some personnel changes at Robert College and an attempt made to modernize both the thinking and the facilities.

The undergraduate training at the Istanbul Technical University is a five year course. Graduates are called "high honor engineers". The University also offers a shorter course for training technicians (who are not classified as engineers). Robert College has only the standard four year undergraduate curriculum for its engineers. Neither school offers any graduate courses although Dean Santur told me he has plans to introduce graduate seminars.

Local Projects

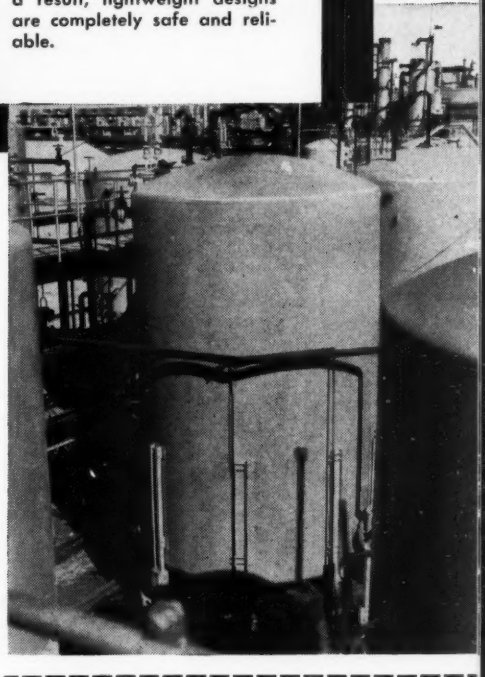
Engineering activity in Istanbul seems to be largely restricted to harbor developments at this time. The Netherlands Royal Harbor Works has a contract for various harbor improvement projects. Worthington Corp. and General Electric have just signed contracts for the complete engineering and construction of a 15,000 ton drydock. A French company has supposedly undertaken the construction of a subway for Istanbul, but nobody is holding his breath on this one.

There is a reason for the apparent stagnation in Istanbul. The city's business is still dominated by a few merchants. Operating by eighteenth century standards with complete and unchallenged monopolies in some instances, they can afford to sit back and count their money. They have neither the interest or knowledge to cope with problems of industrial development, sales, public relations, or management. And as long as they continue to show a profit, who cares! The hope lies with the few progressive leaders and the younger generation, the literal "young Turks." Trained in modern concepts, they realize that the industrial era must replace the mercantile era, even in Turkey. When their turn comes they should be able to aggressively pursue policies that will stimulate the use of investment to develop the natural wealth of Turkey. ▲▲



WELDMENTS of "T-1" Steel—made with AWS 12015 low hydrogen coated electrodes and without pre- or post-heating — develop the full 90,000 psi yield strength. As a result, lightweight designs are completely safe and reliable.

NEW USS "T-1" STEEL has great potential for reducing cost of pressure vessels



You've heard of Operation "T-1." You've heard how those dramatic tests proved that, when and if higher design stresses are permitted, USS "T-1" constructional alloy plate steel will make possible larger, stronger pressure vessels, vessels that can be built more easily and at lower over-all cost. As a result of Operation "T-1," several major pressure vessel fabricators have requested approval from the ASME to use USS "T-1" Steel in unfired pressure vessels. Why? For mighty good reasons:

"T-1" Steel has a very high yield strength – 90,000 psi minimum – three times that of conventional plate steels now used in pressure vessels. Yet it is extremely *tough* and can withstand high stresses and pressures even at temperatures far below zero. What's more, USS "T-1" Steel remains strong at *high* temperatures up as high as 900 degrees F.

Yet, "T-1" Steel is easy to fabricate. It can be drilled, machined, or cold formed, and welded or flame-cut *without* pre- or post-heating. **"T-1" can make pressure vessels . . .**

LARGER. For a given pressure and shell thickness, the *radius* of a vessel may be increased in direct proportion to the ratio of working stresses. Result: more storage capacity at lower cost.

STRONGER. For a given radius and shell thickness, the *pressure* may be increased in proportion to the ratio of working stresses. Result: vessels for higher pressures at lower cost.

LIGHTER, EASIER TO BUILD. For a given pressure and radius, the shell thicknesses may be reduced, thus permitting larger vessels to be fabricated *without stress relief*. Result: lower fabrication cost.

United States Steel, Room 4699
525 William Penn Place, Pittsburgh 30, Pa.

☐ Please send me your booklet "United States Steel presents T-1" which contains the full story of "T-1" steel.

☐ Have your representative get in touch with me.

Name .....

Address .....

City ..... State.....

UNITED STATES STEEL CORPORATION, PITTSBURGH • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS "T1" CONSTRUCTIONAL ALLOY STEEL

SEE THE UNITED STATES STEEL HOUR. It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.

UNITED STATES STEEL

the Legal Aspect

MELVIN NORD
Consultant in Legal and Technical Problems
Registered Professional Engineer
Patent Attorney

Labor Law: Types of Economic Pressure Exerted by Unions (I)

AS INDICATED in my column last month, labor organizations were originally condemned by the courts as criminal conspiracies and later as being civilly wrong (i.e. tortious). Eventually, the courts worked out a legal theory that justifies the organization of labor unions, as well as the exertion of certain types of economic pressure by labor unions — the theory being in essence that unions are simply a new form of "economic competition" and therefore justifiable under the law.

In the present column, it will be our object to begin to examine the question of what activities of labor unions are lawful under this theory.

Strikes in General

The strike is, of course, the basic self-help weapon of labor unions, — the economic weapon *par excellence*. In principle, it is simply an organized refusal of the laborers to work. By analogy with primary boycotts by a group of purchasers from a seller of goods, such activity is now held to be justified as a form of economic competition, and hence intrinsically legal. In principle, management is free to find other workers. Obviously that would defeat the entire purpose of the strike, so the unions always employ additional weapons along with the strike. Whether or not the additional weapons are justified is another question, but as to a strike for immediate direct benefits (e.g. for higher wages or better working conditions) there is no longer any doubt that they are legal. The fact that the union may be stronger than the company or that great harm may be done to the company does not make the strike unlawful, any more than competition by one businessman that forces another out of business would be. The fact that what the union asks may not in the long run turn out to be beneficial to the workers is not important, so long as the laborers honestly believe that they will be directly benefited. Thus, the fact that higher wages might drive the company out of business does not make the strike for higher wages illegal. But a strike for the express purpose of driving a company out of business would certainly be illegal. This would not be economic competition, and hence would not be "justifiable." Whether or not strikes are the best way to solve labor-management problems is, of course, an entirely separate question, discussion of which we can postpone.

Strikes Against Technological Change

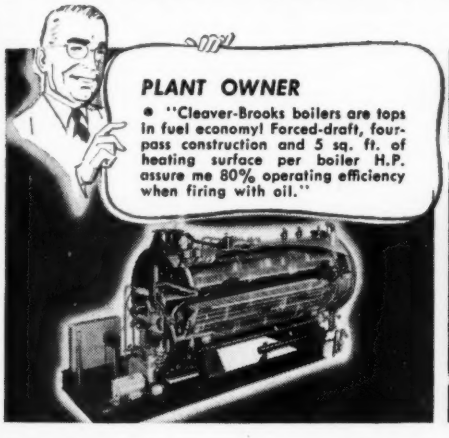
In these days of prospective automation, the question of the legality of strikes against technological change may again become important.

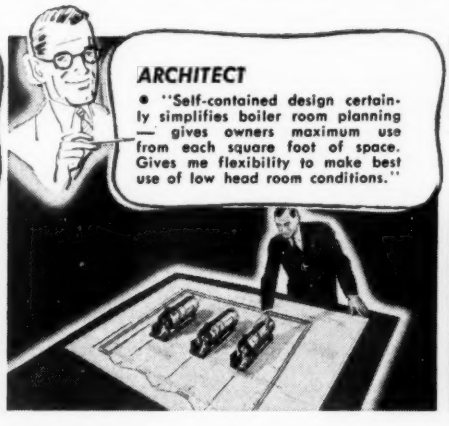
From the point of view of the engineer, management, and society in general, technological advances are properly regarded as beneficial. But in the view of the worker who is likely to lose his job, they may be just the opposite. No one likes to find himself out of a job, but it's much worse when one discovers that his skill, developed over many years or even over a lifetime, is no longer regarded as of any value. In fact, the word "sabotage" was invented when a French weaver threw a sabot (a wooden shoe) into a new-fangled weaving machine.

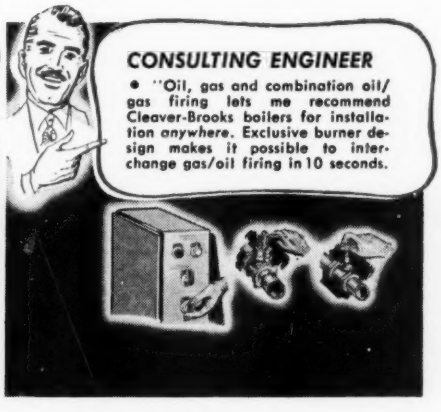
Strikes for the purpose of preventing management from introducing technological improvements have generally been regarded as illegal. Such activities are not regarded as being within the area of economic competition between the union and management. The mere fact that such a strike might be for the pecuniary benefit of the laborers involved would not in itself make it justifiable, any more than putting one's hand into another person's pocket would be justified on the grounds of economic self-interest. Economic self-interest of the laborers may be a necessary condition for the justification of a strike, but it is not a sufficient condition. The crucial factor, according to the general legal theory outlined previously, is that the activities should involve some form of economic competition between labor and management over the terms and conditions of work of people in the employ of the company. If this exists,

CLEAVER-BROOKS SELF-CONTAINED BOILERS HAVE THE FEATURES EVERYONE WANTS!

...which feature would be most important to you?

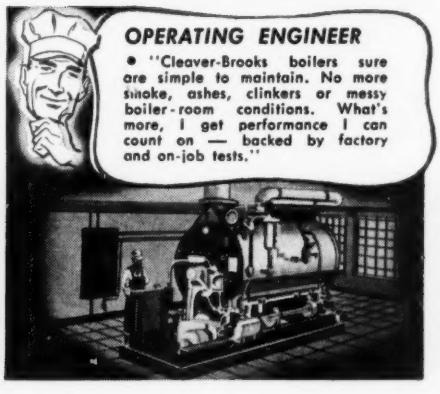

PLANT OWNER
• "Cleaver-Brooks boilers are tops in fuel economy! Forced-draft, four-pass construction and 5 sq. ft. of heating surface per boiler H.P. assure me 80% operating efficiency when firing with oil."

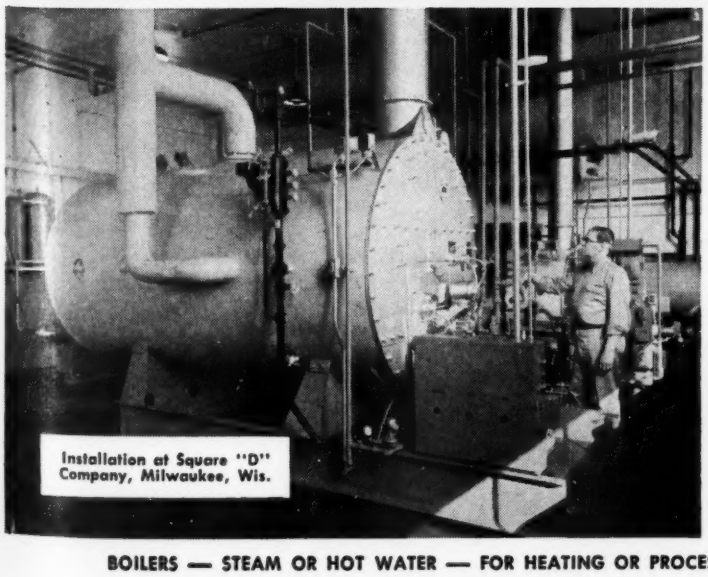

ARCHITECT
• "Self-contained design certainly simplifies boiler room planning — gives owners maximum use from each square foot of space. Gives me flexibility to make best use of low head room conditions."


CONSULTING ENGINEER
• "Oil, gas and combination oil/gas firing lets me recommend Cleaver-Brooks boilers for installation anywhere. Exclusive burner design makes it possible to interchange gas/oil firing in 10 seconds."

CONTRACTOR
• "Boilers are shipped ready to install. With service lines in, my crews have boilers ready for operation in 24 hours or less after delivery. No foundation or stack problems. Cleaver-Brooks furnishes starting service, too."

PLANT SUPERINTENDENT
• "I get all the steam I need for fluctuating steam demands, from full load down to 30% of rating. Automatic burner controls assure instant firing. I call that *real* dependability."


OPERATING ENGINEER
• "Cleaver-Brooks boilers sure are simple to maintain. No more smoke, ashes, clinkers or messy boiler-room conditions. What's more, I get performance I can count on — backed by factory and on-job tests."


Installation at Square "D" Company, Milwaukee, Wis.

THESE are just a few of the many outstanding features that have made more than 15,000 individual Cleaver-Brooks self-contained boilers *first choice* for commercial, institutional and industrial applications. Get in touch with your nearest Cleaver-Brooks representative for complete facts, or write for catalog AD-100. Cleaver-Brooks Co., Dept. H-321 E. Keefe Ave., Milwaukee 12, Wis., U.S.A. — *Cable address: CLEBRO — Milwaukee — all codes.*

Cleaver Brooks

"It's NEW — get the facts on the CB boiler — write today!"

BOILERS — STEAM OR HOT WATER — FOR HEATING OR PROCESSING IN SIZES FROM 15 TO 500 HP, 15 TO 250 PSI.

NOW — FIRST SIZES OF THE CB BOILER ARE MADE IN CANADA, TOO.

NEW
Arnold O. Beckman
MODEL F3
OXYGEN ANALYZER

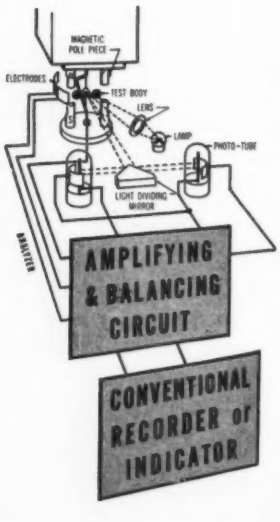
with the meter on the door

New convenience has been built into the well-known F3 Oxygen Analyzer . . . a meter on the door provides readings at the sampling point for making calibration checks, process changes, etc. In fact, complete analyzing, calibrating and indicating components are now incorporated into the single F3 unit—at no extra cost!

Use The Model F3
ON OPERATIONS LIKE THESE . . . TO MAKE SAVINGS LIKE THESE

COMBUSTION Boilers, Kilns, Direct-Fired Heaters, Stills, etc.	*Higher combustion efficiencies at lower fuel costs*
PROCESSING Air Liquifraction . . . Processing Butadiene, Acetylene and Similar Gases	*Better product quality with minimum oxygen or air contamination*
PLANT SAFETY Hydrogenation, Hydrofining, Gas Compressors, Sulfur Grinding, etc.	*Control explosive atmospheres, reduce fire risks, minimize plant and personnel hazards*

Unique Operating Principle



The various applications highlighted above are only a few of the many ways Arnold O. Beckman Oxygen Analyzers—industry's great new profit builders—are being used by progressive operators to boost profits, cut costs.

These are the *only* oxygen analyzers that *continuously* measure process streams by an advanced magnetic principle that provides *direct physical measurement of the oxygen itself*—not of some secondary relationship.

Heart of the unit, as illustrated, is a dumbbell-shaped test body suspended in a magnetic field. Sample gas surrounding this test body causes it to rotate in the field, depending upon the oxygen content of the gas. The movement of a light beam, reflected by a small mirror on the test body, is measured by simple electronic circuits . . . and the result indicated directly on a conventional recorder or indicator. It's simple, positive, accurate!

No chemicals—filaments—catalysts cams—complicated mechanical parts!

***Send for Helpful Free Literature** which describes this unique operating principle in detail—explains its many advantages and applications. When writing, outline your particular operations—we'll gladly supply specific information.*
Ask For Data File 16S-75

FEATURES OF THE F3

Many Ranges: Full scale ranges of 0-5%, 0-10%, 0-15% O_2 and higher.
Accuracy: 1% of full scale.
Multi-Ranges: Any instrument may be supplied with two or more ranges.
***Note:** For ranges narrower than 0-5% O_2 ask about the Model G2.*

Arnold O. Beckman INC
Instruments for Science and Industry
1020 MISSION STREET
SOUTH PASADENA, CALIFORNIA

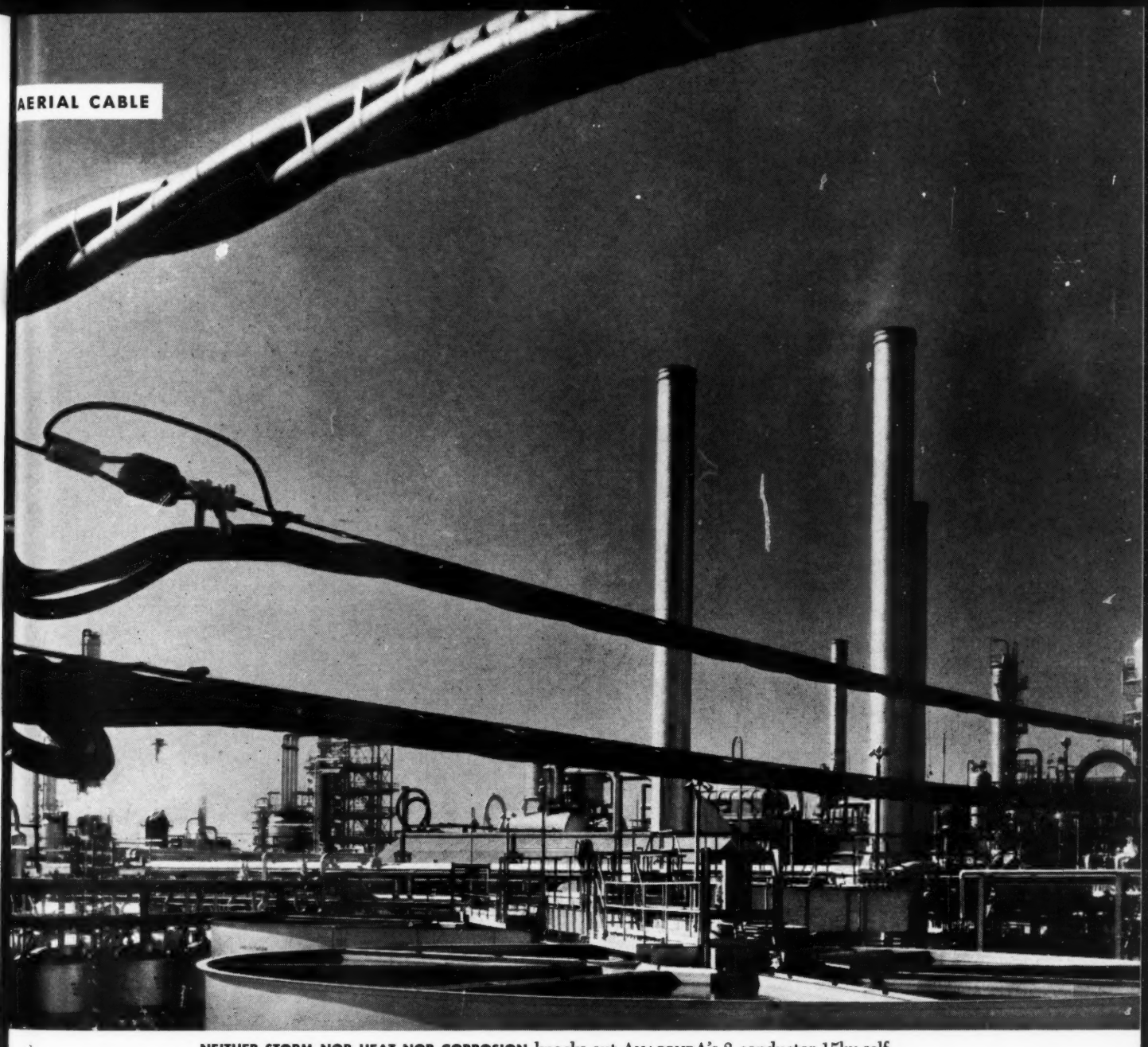
the accompanying economic "coercion" is considered justified; but this does not mean that economic coercion is in itself justifiable.

The fact that courts have generally failed to see any justifiable competition in the case of strikes against technological changes does not, however, foreclose the possibility that their attitude will eventually change. Nothing could be more erroneous than to assume that Labor Law is a fixed and invariable set of rules. All we can do is to present a sort of "still photograph" of where we are at a given time, but one can make a very bad blunder if he forgets that Labor Law is a "moving picture" and not just the "still picture" we may see presented before us. It seems quite reasonable to assume that the question of strikes against technological change may be re-opened at any time, and that the ultimate view may be that this is a factor of such great importance to the legitimate economic objectives of labor that some strikes of this type may be regarded as lawful.

Jurisdictional Strikes

One of the most unfortunate types of strike is the jurisdictional strike, in which two unions engage in a dispute as to which is to do certain work, each threatening to strike if it doesn't get its way. In such a case, the employer has no real interest in the matter, and yet the strike will nevertheless be aimed directly at him.

Strikes of this type have generally been held to be unjustifiable. Sometimes the activity of the union is regarded as not within the area of labor-management competition because the dispute is basically between two unions instead of between labor and management. The mere fact that the striking union has a vital stake in the matter, and that the coercion against management is purely economic, does not save the situation any more than it does in the case of strikes against technological changes. As a matter



NEITHER STORM NOR HEAT NOR CORROSION knocks out ANACONDA's 3-conductor 15kv self-supporting Aerial Cable—shown here at Shell Oil's modern new refinery at Norco, La.

GO UP TO BRING COSTS DOWN

—with AnacondA Aerial Cable

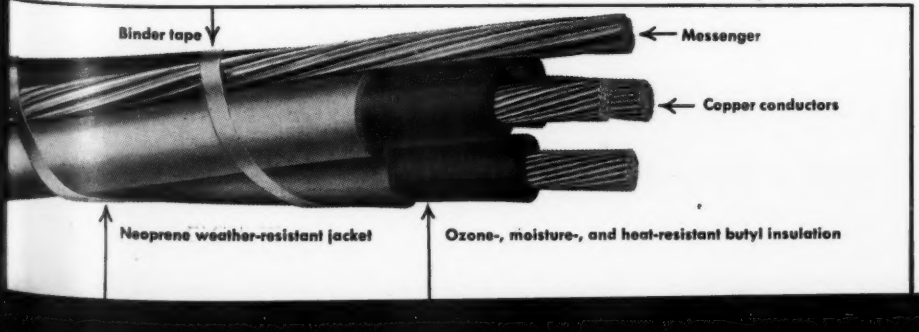
When new power is needed or when old circuits must be replaced quickly and at low cost—more and more plants are turning to ANACONDA Aerial Cable.

In plants where the maze of pipes and other underground structures often make installation of ducts or buried cable costly or difficult. This cable solves the problem.

It's fast, easy to install—particularly in crowded areas. No special ducts or crossarms or insulators are needed. Even in open areas, this rugged, neoprene-jacketed cable costs much less than buried systems.

You can see that it is neat. It is equally safe . . . and reliable!

Today's finest aerial cable! Type AB butyl insulation gives ANACONDA Aerial Cable the finest performance record. For the full story, call the Man from Anaconda today. Or write: Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York. 55279



Ask the Man from

ANACONDA®

about your

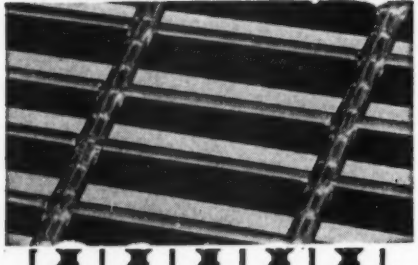
High-voltage Aerial Cable

You Get
MORE THAN GRATING
When You
SPECIFY IRVING

YOU GET...
Over 50 years of engineering skill and production know-how from the FOUNDERS of the open-grid flooring industry.

YOU GET...
A "fitting" grating for every purpose.

YOU GET...
Riveted, pressure-locked and welded Irving gratings in steel; and Irving aluminum gratings in riveted and pressure-locked types, designed for your industrial flooring problems.



YOU GET...
Irving engineering procedures which assure precisely fabricated panels designed from your floor plan or sketch for quick, easy installation.

YOU GET...
Prompt delivery anywhere.

IRVING SUBWAY GRATING CO., INC.
ESTABLISHED 1902

OFFICES and PLANTS at
5056 27th St., Long Island City 1, N. Y.
1856 10th St., Oakland 20, California

of fact, it is clear that there is much less possibility of justification of jurisdictional strikes as economic competition than there is for strikes against technological changes, since the jurisdictional dispute is not really with management. It may be lawful for A to engage in a battle with B in some situations, but that does not make it lawful for A to compel C to help out in the battle.

Jurisdictional strikes have also been regarded as unlawful on another ground. Assuming that they are within the area of "economic competition," they are still unlawful, because they are in the "off-limit area" of unfair competition. While a businessman is free to try to take business away from another company, there are some limits to this too. For example, he is not permitted to threaten the customers of the other company with reprisals if they continue to deal with the other company. Similarly, a union goes beyond the allowable bounds when it attempts to compel a company to break its contract with a different union. To put it another way this is a free country, and I therefore have the right to swing my arm around as much as I please — *except* if someone else's nose is in the way!

Sympathetic Strikes

A sympathetic strike is one in which union A strikes against employer X because it "sympathizes" with union B, which is striking against employer Y. The object is to use X as an unwilling weapon against Y. Such strikes are generally held to be unlawful on the same grounds as jurisdictional strikes.

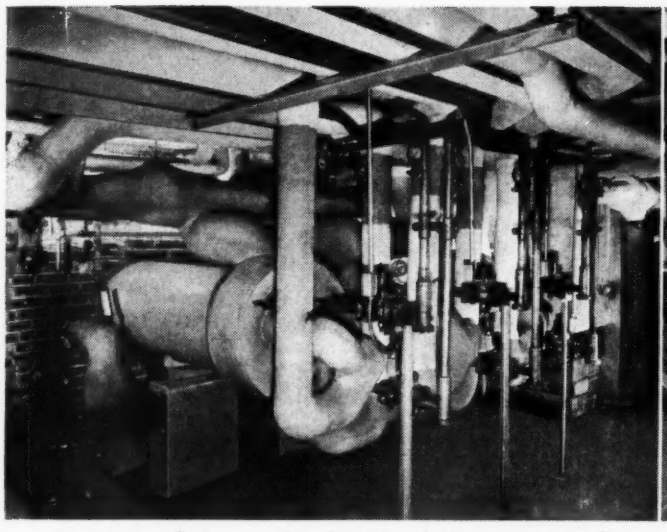
One must, however, distinguish several situations that resemble sympathetic strikes but are not quite the same. Thus, a strike by a "vertical" or industrial type union (e.g. the C.I.O.), in which an entire plant or company is shut down because of a dispute involving one group of workers, is not held to be illegal. There is certainly an element of sympathy involved, but there is nothing *per se* wrong in that. Such strikes are lawful because they involve direct economic competition between the union and management.

A second involves a Labor Union Council, in which a group of "horizontal" unions (e.g. A.F.L. unions), each representing a different craft required on the job, get together to strike against a certain employer with whom one of the unions has a dispute. If there is some functional relationship between the unions (as in the building trades — carpenters, bricklayers, electricians, etc.) there is no real reason to treat the situation as any different from a strike by a vertical union, and the courts have so held. But where there is nothing but "sympathy" between the unions, the result is generally the opposite.

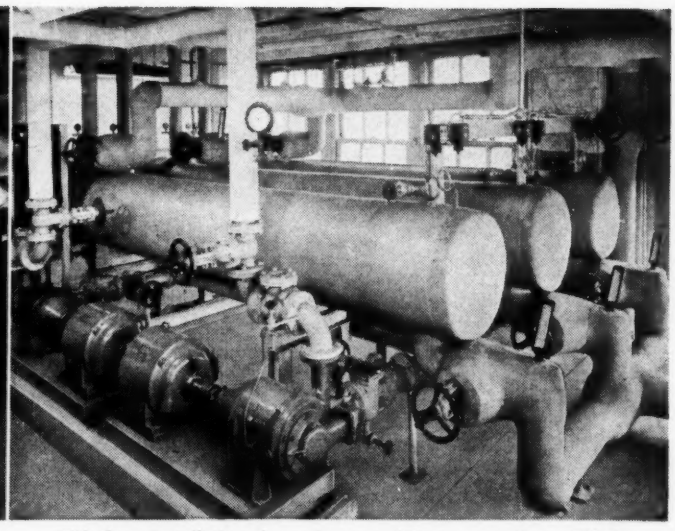
Unions are not always willing to be sympathetic one with the other. For example, just this last May, the Minneapolis Federation of Honeywell Engineers (ESA), an engineers' union, struck against the Minneapolis Honeywell Regulator Co. ESA tried to get the AFL to respect its picket lines. The secretary of the AFL Teamsters Union refused to go along because the engineers' union "is an independent organization—and it means just that, that it chooses to be independent of the labor movement except when it gets into trouble."

This attitude on the part of AFL caused a nasty exchange of words between the two unions, but AFL refused to give in, and the strike of engineers ended after a week.

The third situation is the general strike. This type of strike is awful, not lawful. It is a "sympathetic" strike to the nth degree, and is therefore unlawful to the nth degree. A general strike is to economics what war is to football, what the plague is to vaccination, what cancer is to cell growth. With these kind words, we bid the subject of the general strike a hasty farewell. ▲▲



These three p·k Freon coolers, located in the basement, protrude through brick wall to save space.



Fifth floor installation shown here conditions upper floors. Third floor chillers serve cooling tunnels.

for perfect candy kitchen weather

LOFT'S USES p·k COOLERS

Schwerin Air Conditioning Corp. specified Chrysler Airtemp Units with p·k chillers to keep Loft's 8-story Long Island candy kitchen at just the right temperature and humidity for candy perfection.

You've seen soft, sticky, unappetizing candy you wouldn't want to eat. But you won't see it at Loft's. This big Eastern candy manufacturer has an unusual ability for maintaining the highest standards of quality 'buy-appeal'. And one important reason is its thorough-going air conditioning system employing Chrysler Airtemp units and six p·k dry expansion Freon coolers, engineered and installed by Schwerin Air Conditioning Corp., New York.

At Loft's both humidity and temperature must be rigidly controlled, for when humidity gets out of hand, candy is unsaleable.

So the reheating principle is used to cool the air, and "wring" it to the proper humidity. "Two-circuit" type p·k Freon coolers which chill a glycol solution are located in the basement and the third and fifth floors, to serve nearby areas. Air from conditioned areas passes around coils chilled by the glycol solution and air temperature is reduced some 25°F. to 43°F. A water spray cleans the air, and increases its humidity to 97%. Then the air is circulated around heating coils where its temperature is raised to 60°F. and humidity reduced to 51%—just the right "weather" for perfect candy-making.

The six p·k Freon coolers are automatically controlled; operation is simple. Because the coolers are enclosed, the Loft system is a *clean* system. Compact p·k Freon coolers require minimum floor space, minimum insulation.

If you, like Loft's, have a tough "indoor weather" problem, p·k heat exchange specialists would be glad to assist. More than likely they'll have answers to your particular questions. Write today for illustrated literature and engineering suggestions.

The Patterson-Kelley Co., Inc., 1770 Burson Street, East Stroudsburg, Pa.

PATTERSON-KELLEY

2568

Offices: 101 Park Avenue, New York 17 • Railway Exchange Building, Chicago 4 • 1700 Walnut Street, Philadelphia 3 • 96-A Huntington Avenue, Boston 16 • and other principal cities

the Range Finder

DR. GERALD J. MATCHETT
Department of Business and Economics
Director, National Center of Dynamic Equipment Policy
Illinois Institute of Technology

. . . games and business strategy

ASSOCIATED WITH "automation" as the key word to the next step in industrial progress is "cybernetics." "Cybernetics" describes the entire study of messages as a means of control—whether this control is applied to machines, to living organisms, or to social bodies. It was coined by Norbert Wiener, Massachusetts Institute of Technology mathematician associated with some of the most spectacular advances in automatic equipment.

The replacing of human or animal energies by machines is not, of course, a novelty. After all, mankind has already weathered the stresses and reaped the benefits of one Industrial Revolution. A good many machines of today were propagated from ideas or hunches of scientists and mechanics of earlier centuries. Moreover, it has been well remarked that the precision required in the production of present-day equipment is possible only because of earlier work on lathes and other fundamental types of tools.

What distinguishes the modern period, above all, are the advances in the *control* of machines. Wartime research in electronics and communication techniques led to the development of control equipment, like the efficient new computers, that make the automatic assembly line possible. These new forms of control are basic to automation in the modern sense. They are also the basis for the field of cybernetics as a whole.

Nature of New Machines

It has become customary to speak of the new computing machines as "brains." The almost-living character of these machines lies not only in the things they can do, but in their structure. An inherent feature of the new computing machines and related devices is the presence within them of what might be called sensory organs. The machine itself observes changes in the environment it controls and responds to them. In principle, any quantity that can be measured by an instrument can be "sensed" by an appropriately constructed machine.

Another feature of the new machines is "feedback"—control of the machine's actions by its actual, rather than expected, performance. The driver of an automobile does not simply set the steering wheel to follow the white line on a straight road. He is constantly correcting in order to maintain the desired course. In the same way, the machine continually checks its performance and reacts to what it has already done.

It is not inconceivable that a machine might be made which would "learn" to play chess by practice with human players. Its skill would depend on the caliber of the opponents with whom it had had experience. It is also theoretically possible to construct a "gameplaying" machine, not only able to evolve a policy by learning, but able to baffle opponents by using several different strategies on the basis of built-in probability considerations.

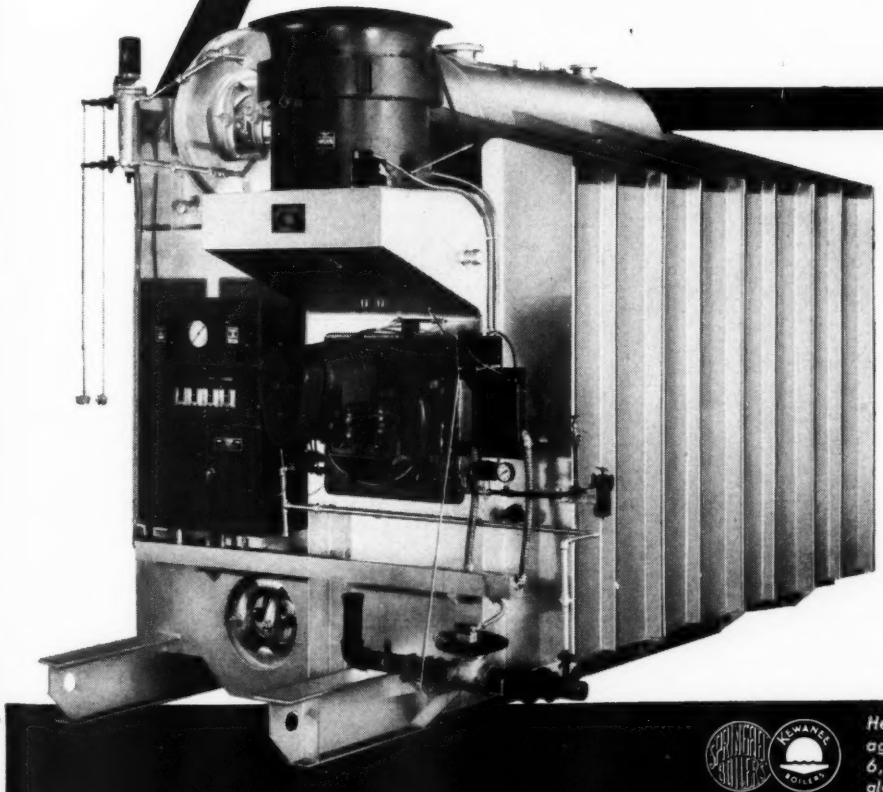
The consulting engineer finds immediate interest in the industrial potentialities of these new machines. Already there are instances approaching the completely automatic factory in the sense that the raw material entering the plant is fabricated and packaged without the intervention of human operatives. But one impediment to extensive automation has been the cost of the complicated computer-like machines required. These machines are still largely in a developmental stage. It is likely that the time is near when mass-production methods may be applied to the production of these machines. The resulting decrease in cost would make them far more practical for wide industrial use.

A single, basic machine can cope with a considerable variety of industrial situations. A specific situation can be handled by the specific orders given the standard machine. This giving of orders calls for some sort of data input, and is a highly specialized operation in itself. However, it is to a large

Announcing one of the most significant additions to our product line . . .

KEWANEE - SPRINGFIELD

water-tube package generator



Here it is—Kewanee-Springfield Water-Tube Package Generator available in 14 standard sizes—6,000 to 45,000 pounds of steam per hour, or equivalent in high temperature—high pressure hot water.

Now from one source Kewanee offers you the broadest selection of boilers in the U.S.A.

When a new member is added to the family of products at Kewanee you may be sure much thought preceded such a move . . . thought of how you could better be served.

So with years of research and practical field experience behind us, we present the Kewanee-Springfield Water-Tube Package Generator. Manufactured by the Springfield Boiler Company and marketed coast-to-coast by Kewanee, it means from 1 source Kewanee now brings you the broadest selection of boilers in the U.S.A.

The Kewanee-Springfield Water-Tube Package Generator is the most compact power plant type unit. Specially selected, durable materials plus 2 drum bent tube design makes for maximum use of boiler space to deliver the greatest steam output. Steel encased—a complete unit with no extras required. Exclusive "6 wall" cooling permits high heat release rates.

All this adds up to lower operating cost . . . less fuel is required to deliver heat due to smaller heating surface with higher heat absorption. Maintenance cost is lower, too . . . double panel casing construction makes tubes easily accessible. Guaranteed maximum continuous capacity . . . can operate at peak loads without interruption.

KEWANEE-ROSS CORPORATION, Kewanee, Illinois

(Division of American Radiator & Standard Sanitary Corporation)

Serving home and industry · American-Standard · American Blower
Church Seats & Wall Tile · Detroit Controls · Kewanee Boilers
Ross Exchangers · Sunbeam Air Conditioners

YOU can depend on KEWANEE-SPRINGFIELD engineering

Heads up to 350 ft.

JOHNSTON TURBINE PUMPS

with a

JOHNSTON UNIT-LINE SUMP PUMP

—easy to install
—economical to operate

Because of multi-stage and centrifugal diffusion vane construction with balanced hydraulic forces, the Johnston Unit-Line Sump Pump is the only sump pump that can pump up to 350 ft. of head — 2½ to 3½ times that of ordinary sump pumps. *Only* Johnston makes a *packing-less* and *seal-less* Unit-Line Sump Pump.

Designed by the engineers who invented and developed the vitreous enameled bowl, Johnston Pumps are backed by half a century of experience and know-how as one of the world's leading manufacturers of vertical turbine pumps. *Mail coupon today and learn how Johnston can solve your industrial pumping problems.*

This Johnston Pump is one of the many popular and dependable Johnston Models.

JOHNSTON PUMP COMPANY
Bin "K"
Pasadena 15, California

☐ Send Bulletins ☐ Have Representative Call

Name_____

Address_____

City_____ Zone____ State_____

CE-75

extent a once-and-for-all operation. The cost can be spread over a considerable output.

One problem that has been significant in some plants having introduced advanced automation is maintenance. Here again, however, the magnitude and significance of this item may well decline with additional improvements and experience.

In an entirely automatic factory, the production process itself would not be the only phase of the operation where human effort would be eliminated. Production data would be fed directly into a mechanized accounting set-up, and a large amount of hand clerical work could be eliminated. Quality control could also be left to mechanical devices. In fact, some observers believe that clerical operations of a largely routine and repetitive nature are prime candidates for further mechanization—such as insurance, banking, and mail order businesses.

Least susceptible to the introduction of automatic techniques are operations necessarily conducted on a small scale, or those producing highly differentiated or custom-made products where essentially new data input would be needed for each job. The demand for personalized goods and services produced by such industries probably will be increased because of the additional leisure made available by automatization of mass production.

Norbert Wiener has estimated — emphasizing the roughness of the estimate—that the new machines will come into their own in some 10 or 20 years, barring a war. He, like other experts in the field, expects that the economic and social readjustments required will be very difficult. Wiener's book, *The Use of Human Beings,* discusses these problems. The new machines are thus a challenge not only to physical scientists and engineers, but to social scientists and enlightened business management. ▲▲

IF...

- You are spending too much time getti tool to and from an operation
- You are having trouble controlling ac tion under tension
- You need a more precise operation trol scrap
- You need hair trigger control of q quantity and size
- You want to start and stop your pr line faster
- You would like to leave your producti line virtually unattended hour after hour
- You require re-acceleration of a motor to previous exact speed
- You want centralized control
- Your mechanical transmission parts wearing out or getting out of adjustment

Or if you have other motor-drive probl our sales engineers are prepared to give the benefit of our 50 years' experience. J get in touch with your nearest Reliance di trict sales office, or write to *Applied Engineering Division, Reliance Electric & Engineering Co., 1124 Ivanhoe Road, Cleveland 10, Ohio; Canadian Division, Welland, Ontario.*

L-1486

RELIANCE ELECTRIC AND ENGINEERING CO.

Builders of the Tools of Automation

Notes FROM ABROAD

Europe

". . a tide . . . taken at the flood . ."

If French scientists and engineers have figured correctly, the rise and fall of the tides in the Rance Estuary, located between Dinard and St. Malo, on the Brittany coast, can generate about 208,000 kw, or roughly 550 million kw-hrs per year in the tidal power plant now under construction.

Under the supervision of the big French power company, Electricite de France, and based on calculations worked out at the Laboratoire Dauphinois d'Hydraulique, in Grenoble, the proposed plant will contain 26 units, each unit being made up of a turbine and an 8,500 kw generator.

As the tide comes in, water will cover the turbines until it reaches a depth of approximately 11.40 meters (about 37 feet) at high tide. The turbines will not start to operate until after the tide has begun to fall. Then water will be allowed to enter the turbine intakes, and the turbines will turn until the water in the estuary is at sea level again.

It is considered impractical to use both incoming and outgoing tides. However, according to the French engineers, this loss represents only about 30 percent of the theoretical potential energy.

Engineers in many countries are taking an interest in the project and watching the results of this full-scale attempt to commercially generate electricity from tidal power. Construction is due to start this year and is scheduled for completion in 1960. If the attempt proves to be successful, it will undoubtedly lead to further power developments on other high-tide estuaries.

Aluminum Skin Construction

The first reported use of aluminum outer walls in European construction is reported from Kristiansand, Norway. It is claimed that the loss of heat through the aluminum outer walls of this Norwegian ten-story apartment house will be only half as much as the heat loss that would be sustained using common building materials.

High Efficiency Ringstokers

A new idea in stokers is the recently introduced Wagner Universal Ringstoker, developed and patented by the German firm of Wagner Brothers. The ringstoker has a rotary grate of circular construction consisting of three, four, or five eccentric grate rings arranged in tier formation, the number of rings depending upon the rated evaporative capacity of the boiler and the characteristics of the fuel to be burnt.

According to Wagner, the usual type of traveling grate does not take into account the fact that the fuel bed thickness gradually decreases as combustion proceeds along the grate. The ideal traveling grate should become narrower or the grate velocity should decrease as the fuel progresses along the grate in order to ensure an even thickness of fuel from front to back. The ringstoker appears to have solved this problem because the grate area of each individual ring is reduced as a result of the rotary movement and the eccentric arrangement of the rings and because the over-all grate area, from the top ring to the lowest ring, is also progressively reduced.

In actual operation the fuel is deposited on the top ring, travels with the ring until it is pushed or rolled off on to the next lower ring, and eventually after one revolution of this ring, on to the lowest ring where the final burning takes place before the burnt out residue drops into the slag or ash pit. The individual grate rings are driven by an oil-hydraulic servo-motor which can be adjusted to vary the speed of the individual grate rings to give a high degree of flexibility.

The great advantage of the ringstoker seems to be its ability to efficiently burn a wide range of fuels and mixtures, irrespective of size, ash, moisture, or volatiles content. All types of coal, lignites, bagasse, spent wattle bark, wood, and a variety of waste products can be efficiently burned.

The Wagner Ringstoker has found a number of applications in Germany and will shortly be introduced on the foreign market. It is an unusual and interesting development and will undoubtedly find many uses, especially where low grade fuels are fired.

Tunneling Record

A British construction crew using a Swedish tunneling method drove 428 ft in seven working days to establish a new tunneling record for Europe. The mark was made during the drilling of the 10-ft bed width Glen Almond tunnel at the North of Scotland Hydro-Electric Board's Breadalbane project.

The Atlas Corp., makers of the Swedish equipment for the job, reported that six lightweight Atlas drills, weighing 45 lbs, with a

. . . special to consulting engineer

piston diameter of 65 mm, and mounted on pusher legs, were used. The crew drilled over 18,000 ft of shot holes with the tungsten carbide-tipped drill steels. Although the tunnel was being driven through hard rock, the Sandvik Coromat steel inserts wore to wafer thickness without the steels breaking. Better than 9,000 lbs of explosives were consumed during the record week.

Titanium And The Sea

If sea water can be purified commercially and on a sufficiently large scale, the entire economy and development of desert lands bordering on the seas can be radically altered. The key to the age-old problem of purifying seawater may be solved with the increased titanium production in the United States.

Several years ago the Swedish engineer, Baltzer von Platen, developed a system of sea-water purification using titanium. Von Platen's method involved pumping the water into a titanium tank under 300 atmospheres pressure and heating it to 520 degrees Centigrade. However, since titanium was not available in commercial quantities at that time, the system could not be applied practically. Today, with the continuing increase of titanium production in the U.S., von Platen's method is receiving new attention.

Toll Road Precedent

The approval of the French Government for building a 47 km (about 30 miles) toll road to facilitate Riviera-bound motor traffic may establish an important precedent for future toll roads in France. The proposed road would consist of two seven-meter (23 ft) lanes and would require two years and an estimated nine billion francs ($26 million) to construct. The major advantage of the road is that it would avoid the climb over the highest part of the Esterel Massif and would by-pass the bottlenecks around the population centers of Cannes and Antibes. The outlay is expected to be covered by a loan at eight percent interest and repaid by tolls, which would be 30 francs (about eight cents) for passenger cars and 500 francs (about $1.40) for heavy trucks.

Gyro Vehicles

The Oerlikon Engineering Co. in Switzerland is responsible for introducing commercially a new form of drive—the "Electrogyro" —suitable for use on various types of vehicles. In this system, the energy required to drive the vehicle is stored in a flywheel carried on the vehicle itself. The energy storing device, the so-called Electrogyro, consists of a flywheel combined with a three-phase squirrel cage driving motor enclosed in a gas-tight housing filled with hydrogen at a pressure of about 1.5 psig.

Since only a limited amount of energy can be stored in the flywheel, the electric motor is used to bring it up to speed again after the vehicle has covered a certain distance. This can be arranged at the terminals or intermediate points of a regularly run route, a bus route for example. Standard, low voltage, three-phase lines can be used for the recharging process. Since the Gyro vehicles produce no fumes, are practically noiseless in operation, and carry no fuel, they would seem to offer valuable advantages.

In a similar manner, locomotives and motor coaches for standard and light railways, mine locomotives, boats for coastal operation, and ferries can be fitted with Gyro drives. The first orders the Oerlikon Co. received for Gyro vehicles were for mine locomotives with electrogyro drives for various mining companies in South Africa and France. Recently, the city of Johannesburg in South Africa decided to adopt the Gyrobus for city bus service.

Energy Study

The Organization for European Economic Co-operation announced from its Paris headquarters that Louis Armand, Director General of the French National Railways (SNCF) will carry out a study of energy problems in Europe.

For some time now the OEEC has felt that the continued rise in energy production costs will have an adverse effect on the healthy development of the European economy, financial stability of member countries, and living standards of their populations. It is hoped that the inquiry will be able to clarify the problems, evaluate possible solutions, and produce recommendations.

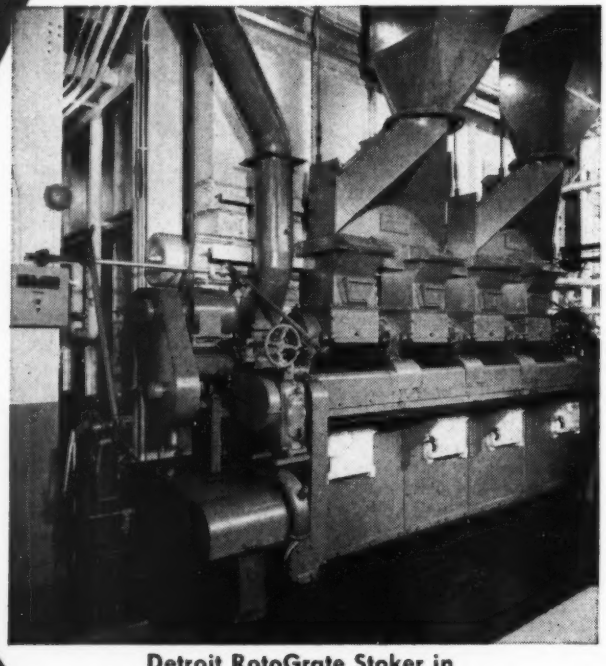
End of Another Era

The announced plans of the British state-run railroads to use atomic-generated electricity as a means of propulsion can effect far-reaching changes. Atomic energy, it is hoped, can put the railroads on a sound commercial basis (the British railroads lost about $56 million in 1954). All steam locomotives will be scrapped over the next 15 years and other forms of power, including gas turbine propulsion, will be used. Large areas of the national network will be electrified, drawing power from atomic plants now being planned by the British Electric Authority. Hundred-mile-an-hour streamlined trains will run on the main-line routes. Yards and stations will be radically altered to give more efficient service. And ultimately, the plan could mean a saving of 15 million tons of coal annually. ▲▲

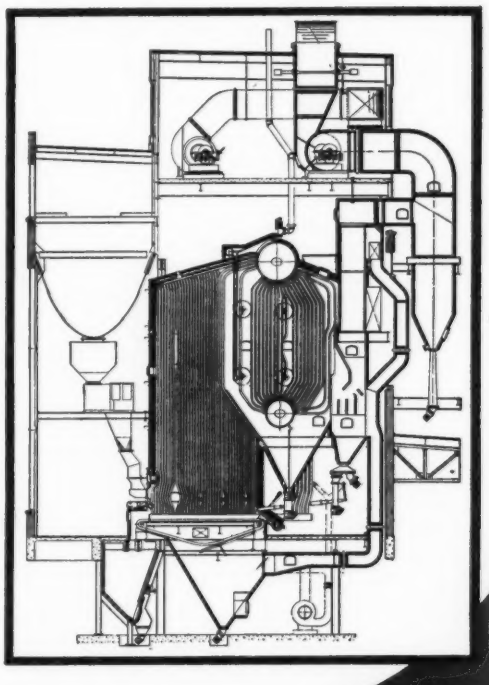
Detroit RotoGrate Stoker

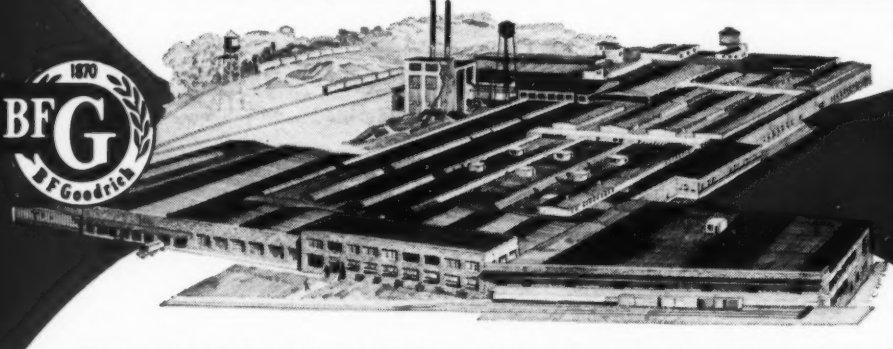
SELECTED FOR TIRE PLANT

The B. F. Goodrich Company, Oaks, Pa.



Detroit RotoGrate Stoker in
B. F. Goodrich plant at Oaks, Pa.



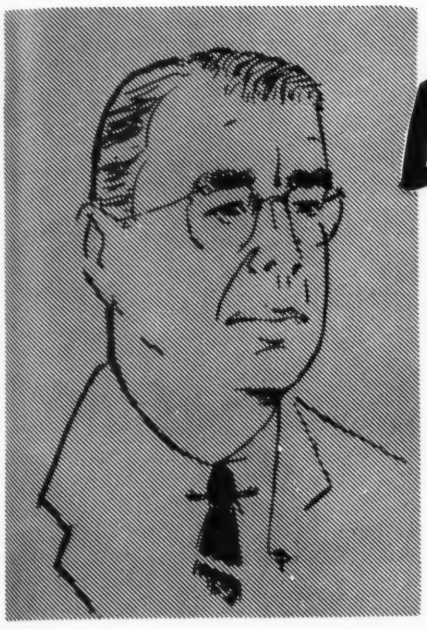


This Detroit RotoGrate Stoker is installed with a Wickes two drum Steam Generator, capacity 115,000 lbs. per hour at 300 psi and 440° F. Design is based on using 350° F preheated air, when burning Fairmont District West Virginia coal. This is part of an expansion program at this plant. Detroit RotoGrate is an advanced spreader stoker with specially designed overlapping grates that move slowly forward, discharging ash at the front. Any Bituminous coal or Lignite, and many types of refuse are successfully burned. High burning rates per square foot of grate and exceptional flexibility make this stoker popular. Detroit RotoGrate will save you money—improve your operation.

DETROIT STOKER COMPANY
GENERAL MOTORS BLDG.—DETROIT 2, MICH.
District Offices in Principal Cities • Works at Monroe, Mich.

DETROIT SINCE 1898 STOKERS

7106



Economic News Notes

E. F. Mac Donald
INDUSTRIAL ECONOMIST

ELECTRONIC WEATHER-GUESSER — Mr. Walter Williams, Under Secretary of Commerce, in a recent speech described the newly created Joint Numerical Weather Prediction Unit, a cooperative venture of the Weather Bureau, Air Force, and the Navy. The use of a high-speed, electronic computer enables the weather experts for the first time to base forecasts on complex equations of physics. Previously, this had been precluded by the very lengthy, time-consuming calculations required. Mr. Williams stated that the new operation will permit more accurate predictions of hurricanes, tornadoes, and other destructive weather. Seems like something that might be of great advantage to construction people.

GROWTH AREAS — The greatest amount of industrial expansion for defense production in the past five years has occurred in states Ohio, Indiana, Illinois, Michigan, and Wisconsin. This East North Central region led the nation in both value of investment — $4.6 billion — and number of projects — 5,126 — under the accelerated amortization program. The Middle Atlantic region was next with an investment of $4 billion and 3,676 projects. Further information may be obtained from a report, "Industrial Defense Facilities Expansion," published by Area Development Div., U.S. Dept. of Commerce.

NO CURE-ALL — Pointing out that 78% of fatal traffic accidents occur on straight and level roads and only 22% on some combination of curve, turn, grade, or crest of hill, Mr. P. H. Blaisdell, traffic safety director of the Association of Casualty and Surety Companies, stated recently, "Improved highway designs are in the direction of a type which apparently produces more accidents rather than less. By the elimination of a curve we seem to invite greater speed . . ." He emphasized the need for accompanying modern highways with stepped-up traffic-law enforcement and tighter control to reduce accidents.

OPERATION COOPERATION — Virginia Electric & Power Co. has announced plans for construction of a $20 million steam-generated power plant on the York River in Tidewater, Virginia. Near the American Oil Co. refinery now under construction, the power plant will use petroleum coke and gas from the refinery as its fuel. Vepco and American Oil put heads together for a number of months to work out the use of by-products as fuel for power generation.

QUOTE-OF-THE-MONTH — Prof. V. Lewis Bassie, University of Illinois, is the source of the following "worth repeating" statement: "The so-called 'built-in' or 'automatic' stabilizers of the economy are 'moderating influences' only. They cannot prevent, but only cushion, a setback; and their effectiveness will weaken as a decline progresses."

HIGH LEVEL — The Structural Clay Products Institute has announced that the brick and tile industry is basing its planning and expansion on the assumption that sales of new homes will be over one million annually for at least the next five years. It points out that two "vitally important" economic developments affecting the housing market are the increased productivity of workers resulting in higher per capita income and, second, the "revolution" that has taken place in the past 25 years in income distribution.

MUNICIPAL LANDLORD — Tennessee has joined the ranks of those relatively few states that specifically permit their cities and counties to issue bonds to finance construction or purchase of industrial facilities for lease to private concerns. The Tennessee law requires general obligation bonds; most of the other states permit use of revenue (self-liquidating) bonds.

SUGGESTED READING — Recent reports of interest to CE's include: "Requirements for State and Local Public Works Construction," May issue of Construction Review. "Potential Economic Growth of the U.S. During the Next Decade," Joint Committee on the Economic Report. "Progress and Feasibility of Toll Roads and Their Relation to the Federal Aid Program," House Doc. #139, 84th Congress, 1st session. "Housing Markets," May issue of Federal Reserve Bulletin.

THROUGH THE TRANSIT — The average age of all construction firms in the nation in 1951 (latest date available) was a little over three years . . . . Massachusetts manufacturers plan to spend 49% more this year than last for new plants and additions . . . . In sharp contrast to the stability in the first half of last year, prices of construction materials and equipment have been rising so far this year . . . . Along with the prevalence of close bidding, rising construction costs are going to shave contractors' profits . . . . The "Twenty-Second Inventory of Available Industrial Plants in the Counties of Maryland" is available from Maryland State Planning Commission, Baltimore.

ATOMS IN ACTION

THE UNITED STATES GOVERNMENT will be represented at the United Nations Conference on Peaceful Uses of Atomic Energy, at Geneva, Switzerland (Aug. 8-20) with two exhibits; The AEC prepared exhibit at the Palais des Nations which will include the swimming pool reactor; and the U. S. Information Agency exhibit at the Exhibition Hall at which certain industrial firms will show, by USIA invitation, reactor models and other items of equipment deemed "educational." In addition to these two official exhibits, at least 17 U. S. industrial and business firms will exhibit in the Geneva Exhibition Hall — without benefit of government auspices. Two of the 17 are understood to have rented space on their own: Minneapolis-Honeywell and Tracerlab. The other 15 firms are joining in an integrated exhibit organized and managed by Molesworth Associates, a New York public relations and advertising firm specializing in the nuclear field.

THE ATOMIC ENERGY COMMISSION has invited the governors of the 48 states to send representatives to a conference on the health and safety features of AEC's regulations to govern licensees. No date has been set as yet. The conferees will discuss, among other things, regulations now under preparation which "will prescribe maximum permissible limits of radiation exposure, and will establish requirements as to radiation monitoring, radioactive waste disposal, and related matters."

KAISER ENGINEERS' Atomic Energy Division, under contract to the Idaho Operations Office of AEC, has started work on the design of an Engineering Test Reactor that will provide irradiation facilities larger than those now available for testing materials related to the development of cores, fuel assemblies, and other reactor components. General Electric Co. will work with Kaiser on certain specialized phases of the nuclear design.

THE DUAL-CYCLE BOILING REACTOR, which will power the proposed full scale nuclear electric generating station that General Electric will construct for Commonwealth Edison Co., near Chicago, "helps take industry past the pioneering stage in the development of practical peacetime use of the atom," according to Francis K. McCune, general manager of GE's Atomic Products Div. The reactor accommodates itself to demands of the power system without requiring changes in reactor controls. Steam is provided to the turbine at two pressures, i.e., 600 psi from the reactor vessel for the first turbine stages and 350 psi from the "flash tanks" for intermediate stages.

ACCORDING TO A SURVEY made by the Atomic Industrial Forum, Inc., between three and five million kilowatts of electric capacity may have to be built and operated on an uneconomic or break-even basis before reactor-generated electric power can become competitive with conventional power. The report also shows that by 1965 atomic energy developments, both government and private, will call for 30 to 40 thousand scientists and engineers — about double the number in both categories today. For a copy of the full report write to Atomic Industrial Forum, Inc., 260 Madison Ave., New York 16.

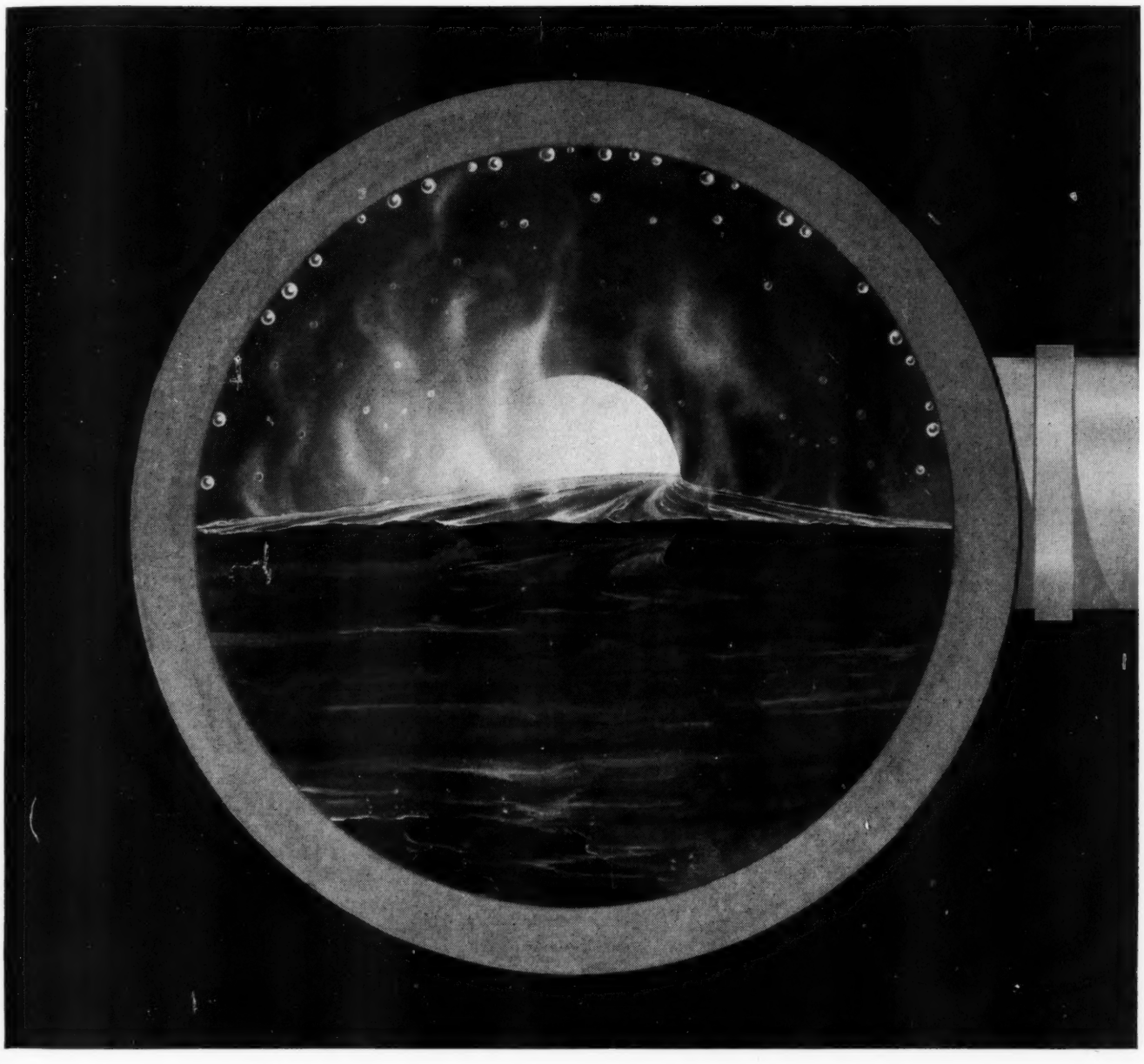
AMERICAN RADIATOR & Standard Sanitary Corp. is the latest entry to establish a division to coordinate activities in the atomic energy field. The company not only plans to manufacture atomic power and propulsion equipment but will work on design of complete primary reactor systems. Three operating divisions, American Blower, Detroit Controls, and Kewanee-Ross, have been manufacturing components for some time.

CONSTRUCTION has begun in Chicago on a $1¾ million research building to house the nation's first private nuclear reactor for industrial research. To be owned by Armour Research Foundation of Illinois Institute of Technology, the reactor will operate at 50,000 w and will be used solely for research on industrial problems. About 20 industrial concerns will participate in the Foundation's reactor program at $20,000 per. In return, they will share in benefits derived from the research for three years. The reactor will be moderated and cooled with ordinary water. North American Aviation is designing and constructing the reactor at its Downey, Calif. plant.

BABCOCK & WILCOX CO. has developed a new inspection tool that makes use of radioactive Cobalt 60 to "see through" steel up to seven inches thick. Called the Isoscope, the unit requires only 1/3 the exposure time of a million volt X-ray unit, costs less initially, and requires less secondary radiation shielding.

A TINY SEMICONDUCTOR DEVICE, a silicon junction, that converts either light or atomic radiation directly to usable electrical energy has been developed by Radio Corporation of America. The device, similar to those used in transistors, has been used in experimental solar and atomic batteries. These batteries, which use light and radioactive material interchangeably as sources of radiation, were used to power a specially designed low-power transistorized radio receiver.

ANOTHER MAJOR URANIUM strike has come to light with announcement of the signing of a contract to expand mining operations on the Mizpah Uranium and Oil Co. properties in northeastern Wyoming. Geologists estimate that over $3 million worth of ore in grades running as high as four percent U_3O_8 will be taken from the five claims.



WHAT'S A MONOMOLECULAR FILM?

It is a film one molecule thick. Filmeen* in steam or condensate lines produces a monomolecular film.

But, there's a lot more to it than thickness. The film's most important function is protection against corrosion. By forming a nonwettable coating on all metal surfaces with which treated steam or condensate come in contact, Filmeen provides a protective, corrosion-inhibiting barrier between water and metal. In heat exchange equipment, the condensed steam treated with Filmeen then forms as spherical drops of water which resist adherence to the film surface, much the same as a drop of water will form into a small ball on a waxed surface. This phenomenon results in increased rate of heat transfer—which in turn saves money in power plant operation.

When steam condenses on untreated return lines, it forms a continuous layer of water that restricts heat transfer. You don't want that... it raises the cost of heat.

Your Dearborn sales engineer will gladly explain how Filmeen can keep your heating costs in line.

**Filmeen is the trade-mark of a corrosion-inhibiting compound produced exclusively by Dearborn Chemical Co. U.S. Pat. No. RE 23614.*

Dearborn®

a leader in water conditioning and corrosion control

Dearborn Chemical Company
Dept. CE, Merchandise Mart Plaza, Chicago 54, Ill.

Please send me complete information about Filmeen.

Name.....*Title*.....

Company.....

Address.....

City.....*Zone*.....*State*.....

IT TAKES ALL THIS TO MAKE A RADAR PROFILE

1. Ground Survey Unit
2. Aerial Survey Unit
3. Radar Recording Unit
4. Survival Equipment
5. Aerial Film Tanks
6. Portable Plot Table
7. Tape Recorder
8. Radar Altimeter
9. Portable Dark Room
10. Survey Altimeter
11. Stop Frame Projector
12. 16mm Bolex Camera
13. Polaroid Camera
14. Fairchild Aerial Camera
15. Keystone Aerial Camera
16. Battery Equipment

Profiling the Earth From the Air

W. C. EDDY, Captain, USN (Ret.)
Television Associates of Indiana

The portrait at the left is not of Capt. Eddy but of one of the Captain's sometimes bemused and usually bewildered little men who live in a world well known to addicts of the Minneapolis-Honeywell calendars. Bill Eddy has been drawing episodes in the tangled existence of these particularly unskilled but imaginative men for the M-H calendar for many years.

Capt. Eddy is like his cartoon characters only in that he, too, is imaginative. He is a graduate of Annapolis and an expert in things electronic. After the War, Eddy retired from the navy and has been busy producing many of the devices he invented in the audiovisual field. In the meantime he has become one of the country's few authorities in the use of radar as a tool for profiling the earth's surface from the air.

RADAR PROFILING is a relatively new method of determining contours over proposed microwave communication paths. Its demonstrated adaptability over all types of terrain has already created considerable interest in this technique as a quicker way of developing profile data for yet other purposes.

The techniques and equipment that made such a system possible date from the post war period when vertical radar equipment became available. The basic theory was simplicity itself—merely one of flying an observation airplane at a fixed altitude over a given path and recording the vertical distance to the ground at frequent intervals. Just as with many theoretical approaches, this idea did not immediately work out in practice.

In late 1945, television station WBKB of Chicago, received permission from the officials of Notre Dame to broadcast the football games from its South Bend station if the station could provide the communication system required. Microwave point to point equipment capable of transmitting the broad band television signal over line of site distances was just then becoming available, so a network of repeater stations linking South Bend and Chicago was proposed. Such an ultra high frequency system could, however, only be operated over a series of short line-of-site paths, a factor that required detailed knowledge of the terrain elevations over which the signal was to pass.

Such information was not available for the overland portion of the system through the state of Indiana. To obtain such detailed data by usual land survey methods would have entailed months of work and considerable expense.

To meet this problem it was decided to equip a private plane with war surplus radar altimeter equipment and fly the exact path of the signal, observing in the course of the flight the vertical distances between plane and ground.

Such a flight was eventually made. In fact, many such flights were made over the path. They resulted in the collection of a considerable amount of data, little of which could be made to coincide with known check points on the ground. It became obvious from these first attempts that there existed one or more hidden variables in our formula that would have to be found if the system were to be made practical.

Early Results Analyzed

Analysis of our early results proved that the observation plane was incapable of maintaining the exact fixed altitudes required and that the pressure altimeter equipment registering this altitude did not, because of mechanical lag, directly follow the up and down movement of the plane as it rode the waves in the air. It was also apparent that under any but the most ideal conditions, the observation plane would pass from one barometric pressure area into another in measuring a path of any length. This change in barometer directly affected the indicated altitude of the observing platform. It was also obvious that the splash from the vertical radar, i.e., the area of the ground reflecting the transmitted radar pulse, was far too broad for the pinpoint accuracy desired if normal flight altitudes were to be maintained. Substitution of low level barnstorming flight heights, which would automatically reduce the area of the splash pattern, required the development of new piloting techniques to enable the plane to accurately follow the plotted flight path without the benefit of landmarks.

While all of these problems were not completely solved prior to building this South Bend-Chicago network, enough temporary corrections were made in the techniques to develop usable information concerning the terrain and to permit the eventual completion of a successful system.

The accomplishment of the basic mission, however crude the results, did indicate that a potentially important surveying tool was available for future use if flight techniques and electronic equipment could be intercoordinated.

Our first step was to develop a reasonably safe low level flying technique and at the same time train a flight crew to fly an exact flight path at those low altitudes of 50 to 100 feet above the ground. At these altitudes a horizon of 75-ft trees ahead would close in the range of available landmarks to those directly ahead and beneath the ship. Over unpopulated terrain nothing except unidentifiable tree tops marked the course.

The solution was again theoretically simple. From the safe altitudes of two to three thousand feet, the crew found that it could simultaneously observe the locations of the station sites at each end of the link as well as all of the normal landmarks along the intervening flight line. By flying this visual path at such an altitude and noting the various identifying markers as they appeared in terms of seconds of departure from the starting point, a tabulation of landmarks keyed against time could be prepared. Reverse direction flights at the same altitude served as a satisfactory check. Where no landmarks were available, they were artificially created by dropping weighted bags of soot or flour or rolls of paper towelling to create distinctive markers whose location was subsequently plotted in much the same manner as natural landmarks.

With such data in the hands of the navigator, the low flying pilot could be constantly coached as to the next target he would have in sight as a check point. As the plane passed over each marker, the time was called out and recorded on a tape recorder connected into the interphone system. This data was later used in estimating the actual ground speed at that particular instant of the flight. While the 50-100 foot altitude is now standard for this type of work, it is still considered a "non-habit forming type of aerobatics." However, it has been successfully used over nearly every type and condition of terrain both here and abroad.

Operating "too low to jump and too high to walk," the only safeguards that could be provided for the crew lay in selecting a plane capable of surviving a belly crash without loss of life. A commercial-type single engine plane was chosen whose "wheels up" under-section presented no major obstructions that might later cause a somersault if the plane had to

"TOO LOW TO JUMP AND TOO HIGH TO WALK."

DOTTED WHITE LINE INDICATES PROFILE OF EARTH AS DEVELOPED BY RADAR EQUIPMENT IN PLANE.

be skidded in on an emergency ditching operation. The choice of a single engine plane would appear to be the antithesis of our requirements, but the variety of low-powered twins on the market with the particular configuration required was so limited that despite their many safety advantages a single engine plane was selected. While not directly a function of safety, the plane chosen also had good yaw stability close to the ground, making it possible to fly a more exact path.

In redesigning the air frame for its new job, the gas tanks were removed from the cockpit and positioned in pods at the wing tips to reduce fire hazard. At the same time critical parts of the airframe and seat structure were strengthened to withstand the shock of an emergency landing. The crew were provided with crash helmets, shoulder straps, seat belts, Mae Wests, and survival kits, while the electronic measuring gear was positioned for minimum hazard and strapped in the cockpit.

First Major Assignment

Shortly after the basic corrections had been made the system was given its first major assignment in charting the microwave routes for the Union Electric Company system through the Ozarks. While the results of this early survey were entirely satisfactory insofar as delineation of path, obstructions, and sites were concerned, it became obvious that to more fully detail a path, readings of the terrain would have to be taken at maximum intervals of one second or less.

Recording the data on five instruments at such a frequency was an impossibility for an observer making manual tabulations. This made it necessary for us to develop and construct a multiple camera recording system and decoder. This continuous plotting device was first used in laying out the United Gas Pipeline network between Jackson, Miss. and Baton Rouge, La. and was further proved between Muskogee and Chickasha, on a job for Oklahoma Natural Gas Company.

On all three of these assignments the problem of accurately predicting the pressure altitudes that would occur over the various paths being surveyed became a major deterent to accuracy. While multiple radio contact with surrounding airports gave us the trend and existing barometric conditions at the towers themselves, it was impossible to extrapolate this data for the immediate routes being surveyed. Any error in pressure assumption would, after being set up on the altimeters, tend to indicate a false altitude and thereby throw an error into the resultant readings. After considerable analysis and testing of various possible solutions, a technique was devised that cleared this equation. By substituting electrical delay line equipment for the di-pole antennas of the radar after the plane was airborne, it was possible to accurately calibrate the radar against a known standard. Reconnecting the antennae, the plane could then be flown over an area of known elevation, such as a lake in the immediate vicinity of the path to be surveyed. By using the calibrated readings of the radar as a vertical measuring stick, the known elevation of the reference plane plus the additional altitude of the plane (as shown by radar) could be set on the pressure altimeters. A series of runs at varying pressure altitudes over the check point would then prove or disprove the assumed settings.

This method provided an accurate calibration method for our measuring equipment at or near the area of survey, but it did not provide for barometric changes that could occur along the path or between runs. The theoretical profile developed by such means was, however, a true representation of the earth's contour even though it could, because of subsequent pressure changes, vary in slope or position over the actual terrain. We then found that by establishing the height of accurate anchor points at either end as well as at points of obstruction along the path by ground survey methods from USGS benchmarks, the theoretical profile could be easily adjusted to conform with the known elevations in the final processing of the profile.

This improved technique, permitting continuous profiling as well as compensation for area barometric pressure, was first employed in surveying the Texas to Minnesota branches of the Northern Natural Gas Pipeline. The findings were eventually corroborated over many types of terrain even though the aerial readings had been made with wide differentials in pressure gradients.

A satisfactory system for the selection and description of site areas required the use of photographic equipment capable of quick development and high detail. Rather than experiment in this highly complex art, the survey plane was eventually equipped with a series of cameras—35mm color, Polaroid, 3-D, aerial, and 16mm motion picture type. With one or more of these cameras the crew is able to record complete site and obstruction details for further evaluation.

With all our experience we can still see new improvements in both techniques and equipment that

will eventually become part of a more perfect system of electronic profiling. And with each development we find new applications for the service.

Other Methods

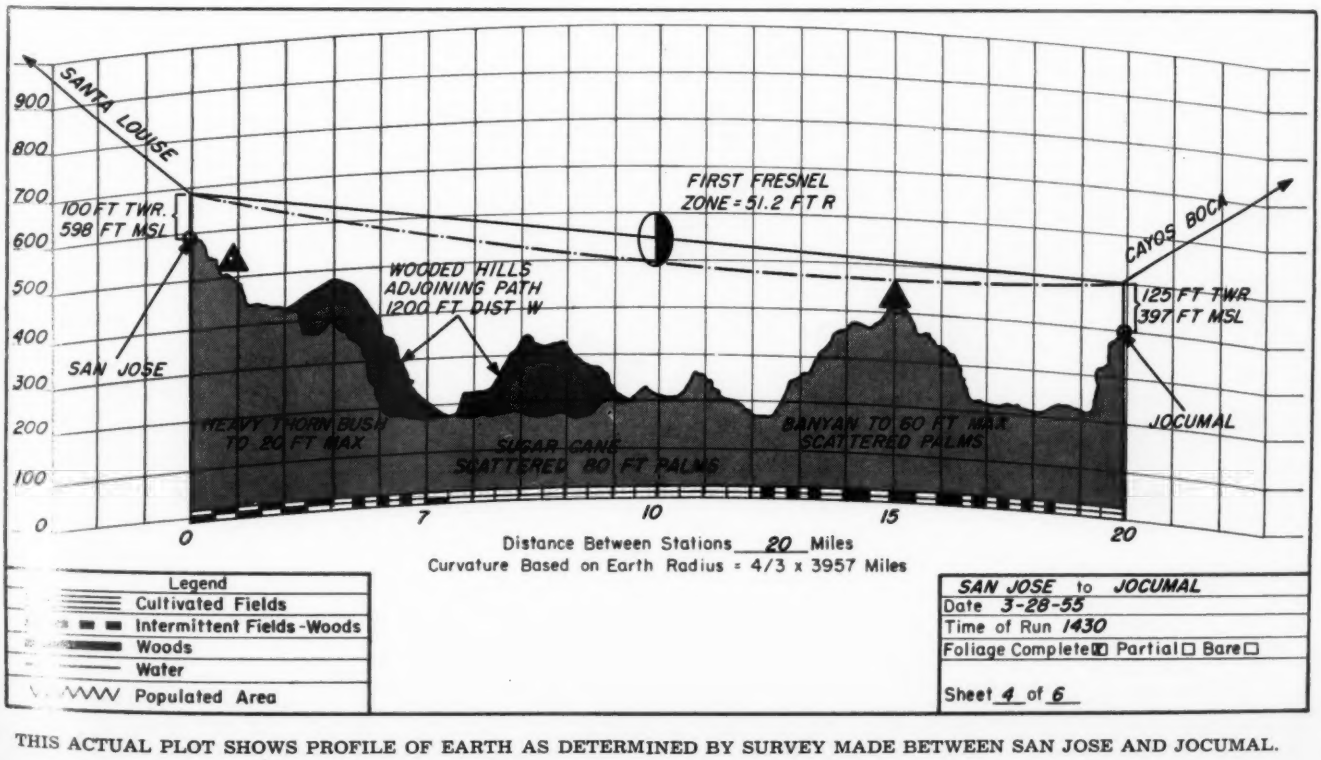
There are other ways, of course, to develop a profile of the earth. The simplest approach is by reference to topographic charts. Where such charts are available and accurate, a usable profile can be developed very easily. Unhappily, only a small section of the United States has been so charted. Photogrammetry has lately led to the development of new issues for many of the more critical areas, but the availability of such charts is limited.

Since photogrammetric topo charts are accurate and form an excellent basis for profile development. It follows then that a photogrammetric coverage of a path would be effective in providing the data required. Cost of such services, however, runs high, and the process is time-consuming. Further, if the resultant profile proves to be unacceptable, the entire process must be repeated over another path which, again, may or may not prove satisfactory. Photogrammetry differs from radar profiling in that it does not provide the quick analysis of contours with the opportunity to develop an alternate path before the equipment is removed from the area.

Ground survey parties using surveyors altimeters are a second alternative and the one frequently chosen today as an economical method of extrapolating profiles from a limited number of readings taken along the path. If such points chosen are those of the potential obstruction and are assuredly on the beam path, this system provides a usable profile. If, however, the reference points are in error, or are not on the true path, the profile is wrong. Ground crews have considerable difficulty in plotting and traversing a straight path unless the expensive and time-consuming techniques of transit, rod, and chain are employed. Furthermore, from the ground it is sometimes extremely difficult to evaluate which hills of a series will eventually comprise the critical tangency, leaving the possibility that in the point profile developed, other points unmentioned but more critical may exist.

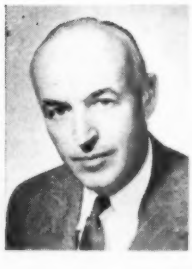
Simple visual determinations of a path's contour are not generally accepted as a sufficient survey. Obviously, if you can see clearly from the top of one mountain to the next and there are no intervening obstructions, it can be assumed that the path is clear, but such an observation still does not produce a profile. If, on the other hand, the path is not always visible and the practice of observing flashing lights is resorted to, the results may prove misleading. Refractive conditions which will abnormally bend the optical path can easily make objects that lie below the true horizon appear visible.

There is no one quick and easy solution to the problem of obtaining an economical, accurate and expeditious contour for microwave planning. All systems have their advantages and their limitations. We believe the radar profiling technique, which we have been instrumental in developing, is a logical engineering approach to a purely engineering problem and one that has great potentialities in many important survey applications. ▲▲



THIS ACTUAL PLOT SHOWS PROFILE OF EARTH AS DETERMINED BY SURVEY MADE BETWEEN SAN JOSE AND JOCUMAL.

ROTATION OF JOB ASSIGNMENTS IS AN IMPORTANT ASPECT OF MANAGEMENT DEVELOPMENT FOR A CONSULTING FIRM.



Developing Tomorrow's Management For Your Consulting Firm

FLORENT E. VERDIN
Management Consultant

CE exclusive

Florent E. Verdin has a degree in electrical engineering from Syracuse University. He taught engineering mathematics for two years at that school and then engaged in engineering sales of electrical equipment. He was for twelve years division personnel manager for Niagara Hudson Power Corporation, and for ten years director of personnel for Cleveland Electric Illuminating Company.

Since 1953 he has been in private practice as a management consultant specializing in management development, supervisory training, organization planning, and executive compensation. He is author of a number of articles on personnel problems and training.

A NUMBER of far sighted companies, aware of the degree to which their success depends on certain executives, have insured those men's lives, with the company as beneficiary. The theory is that such dollar proceeds might tide the organization over some rough seas while a successor is learning the job.

There is grave doubt as to the real or lasting value of such a procedure as far as the continuing success of an operation is concerned. After all, the "Life" people live in an organization is a "Life" that can hardly be replaced by dollars. It is "Life" that provides the power to move the enterprise.

In the consulting field the principals of a firm are often the only contributors to this Management Life in their companies. With the passing of these principals, the organization often goes into a decline leading to extinction. In view of the character of consulting operations, where much time is devoted to providing for the future of clients, we wonder why there should be such a deficiency in providing for the future of their own organizations.

Admittedly, there is a noticeable shortage of men who can handle the important responsibilities required today of top-flight consulting executives. This condition has come about primarily because of a deficiency in the training of managers under three

separate conditions that have existed in the past two decades:

The Business Cycle Effect — During periods of low business activity, the business pace, the movement of management personnel, and the opportunity for employment are at a low level. People not only lack opportunity for development—they may lack employment itself, or may be forced into a complete change of career. These conditions, which were so prominent in the '30's, certainly slowed up the natural rate of management development.

The War Years — The displacement of people by war, the loss of many with high executive potential, and the loss of years of development experienced by others created a void in the ranks of the upward-moving management team. At the same time, an unheard-of expansion of industry brought about an almost proportionate increase in the demand for management personnel.

Post War and Technological Development—Never before in history have the increasing demands upon management come so fast. International situations, government regulations, scientific advances, labor shortages, growth of labor unions, the demand for technical and scientific personnel in government and research fields — not to mention advances in methods, machines, and manpower utilization — have added burden after burden to the load carried by managers and executives.

Specialization

There is yet another important factor. Specialization, which has grown by leaps and bounds, does not contribute to the natural training of men for the assumption of broad management responsibility. This has meant a trend toward stagnation of the old methods by which managers were made.

For many years there has been development of management talent through experience, some self-study, and a great deal of guidance by superiors. A young man, in the course of his career in industry, was expected to learn — in addition to his own job— much about his department, the relationship between his and other departments, and something about the other fellow's job, too. Even though an engineer, he became acquainted with problems in costs, financing, accounting, personnel handling, and other fields. Lately, with emphasis on technical specialization, the inference has grown that the individual should pay attention only to his own specialty.

So the consulting firm finds itself in a rather untenable position. The demand for engineers with management talent is in excess of the supply. Management itself requires more knowledge, more skills, and more tools than ever before in order to assure business success, while the trend toward specialization has decreased the training opportunities for likely management candidates.

Business in general has begun to use management development programs to insure a continuity of management life. Consultants should try the same methods. Students of business are agreed upon certain criteria of good management. These include the development of future management talent as an essential responsibility, a management skill, and a basic job duty for most levels of supervision.

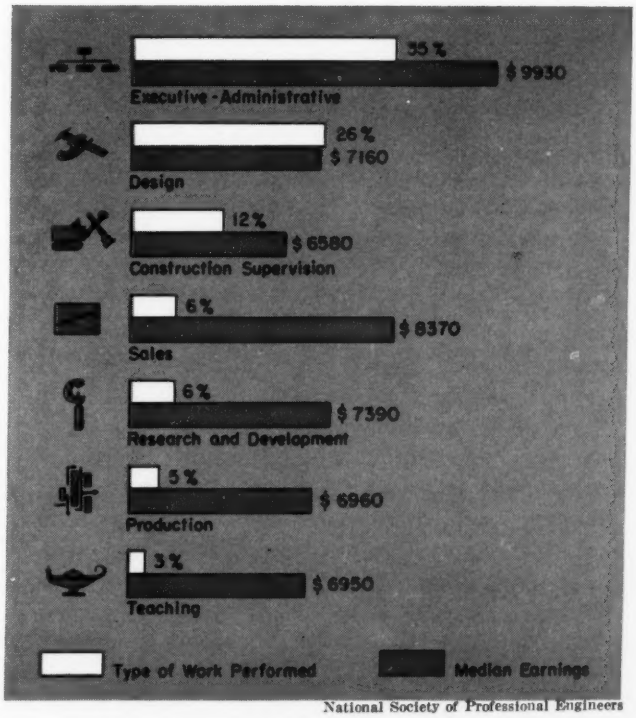
Training for management is not accomplished just by agreeing that it is the responsibility of executives to do so. There are a few ideas that should be digested by those in responsible positions before any definite program of development is decided upon.

Self Improvement

In spite of all of the frequent use of the term "Management Development," people are not "developed" — they develop themselves. All that can be done is to provide the opportunity, the facilities, and assistance required.

Emphasis in any management development program must be placed on self improvement and not upon preparation for promotion. While the company's over-all objective must include the preparation of a pool of reserve executive candidates for the next week, next year, or five years hence, a tendency to over-emphasize promotional opportunity as an objective can do much harm to the morale of the organization and to some of the persons participating in the program.

We read much about sending potential executives, and even senior executives away to Harvard for 13 weeks, or to Michigan for 4 weeks or to Pittsburgh,



National Society of Professional Engineers

WHAT TYPE OF WORK DO ENGINEERS DO, AND HOW MUCH ARE THEY PAID FOR IT? MANAGEMENT PAYS BEST.

Columbia, Stanford, Northwestern, or other schools for various periods of time.

These courses are variously described as designed to "retread executives;" to broaden the viewpoint of participants; to teach them certain specific subjects; to force them to develop good thinking habits with respect to business problems. Those who have attended such programs are seldom able to point to specific and concrete advantages they have gained. Often they are at a loss to answer the question "What did you get out of it?" They are agreed, however, that they had a wonderful experience, and they are sure that both they and the company have benefited.

There is no doubt that such courses have real value in spite of the difficulty in pinning down the specific benefits. This value lies in a combination of gains such as learning how others approach or handle problems; learning how to adjust one's personality and viewpoint to those of others who are as forceful and influential as one's self; gaining certain technical information or knowledge from books or instruction; and what Larry Appley, of the American Management Association, calls "refueling" — getting away from the routine responsibilities and thinking or exchanging ideas about philosophies and principles used in the daily practice of leadership within their own organizations.

These college programs are not the whole of Management Development. They represent only a small part of the over-all job.

Favorable Climate

Going back to the idea that people develop themselves — as opposed to "being developed" — we can create an atmosphere or climate favoring self development by making self improvement easy and almost automatic.

How do we provide these opportunities? That is the job of the supervisor at all levels of supervision. Well over 75 percent of the Management Development accomplishment in any company lies in the day to day relationship between the supervisor and the supervised. One of the greatest failures of supervisory personnel is the failure to recognize the threefold responsibility of an executive in providing for continuity and improvement of management. This responsibility is:

¶ To improve his own performance
¶ To help subordinates improve their performance
¶ To see to it that these subordinates help their own subordinates improve

To develop a man and lead him to the accomplishment of these ends —

Stimulate him:
¶ To think and learn
¶ To set ambitious goals for himself
¶ To build self confidence and respect

Teach him:
¶ As much of your own job as possible
¶ Other company matters affecting your operations

Permit him:
¶ To express himself freely
¶ To represent you at times
¶ To share your management role at times

Require him:
¶ To state his own conclusions
¶ To accept responsibility
¶ To engage in assignments beyond his regular duty
¶ To teach and assist others
¶ To keep you well posted
¶ To make his own decisions

Each personal relationship between a man and his superior will develop certain qualities of its own. What is mutually most acceptable for one relationship may be utterly futile for another.

This is the heart of a program of Management Development. The college type program is one of the lesser organs, and along with it may be included a long list of extracurricular activities such as civic work, club memberships, and trade association activities. Even more effective than some outside activities may be such assignments as conference leadership, research studies, committee participation, report preparation, teaching in company sponsored courses, and managing such activities as tours or social and recreational events.

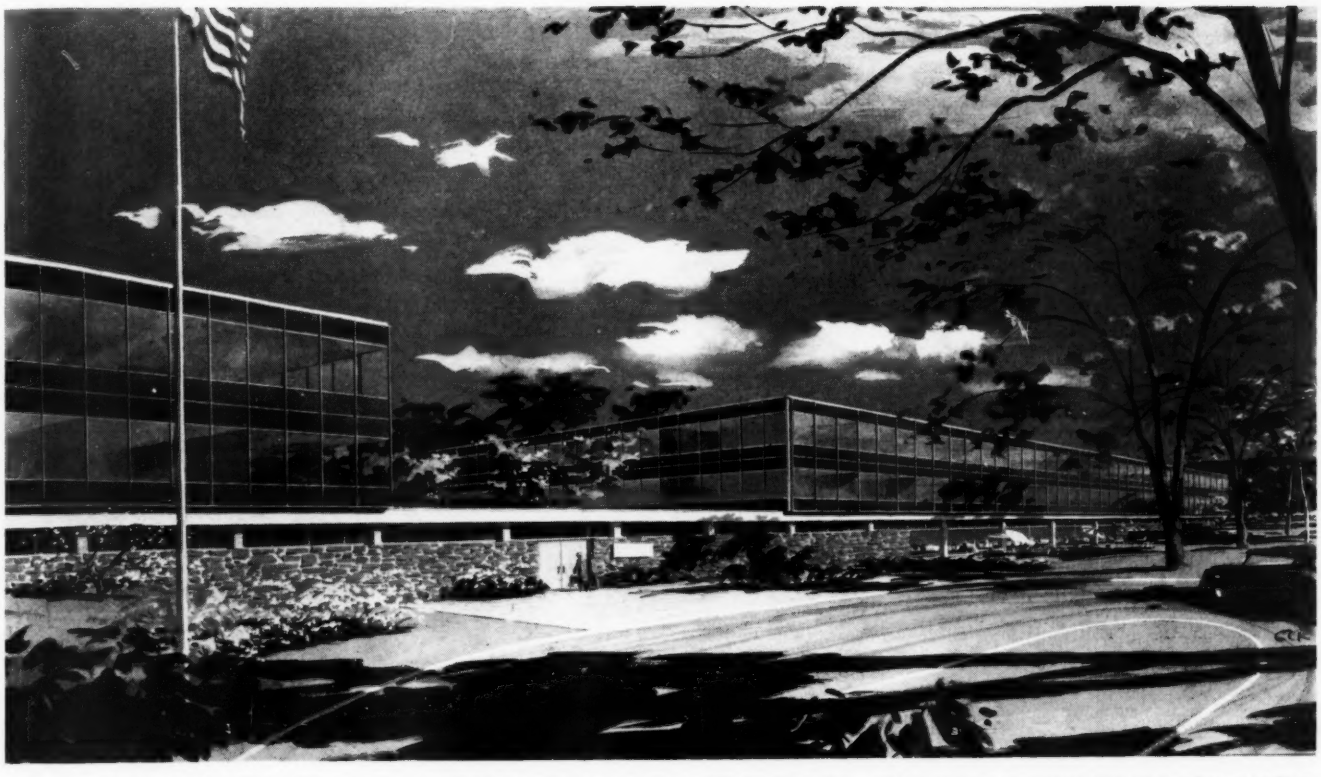
Finally, rotation of job assignment provides great opportunity to learn and develop. By experience in another field, the engineer may learn that one can be an accountant and still be a reasonable human being, or he may discover that all salesmen are not maniacs. There are, of course, limitations on rotation of assignment, but the job would certainly run more smoothly if the field supervisor better understood why the design engineer set certain specifications — or if the designer had a chance to see, in the field, that a square peg in a round hole is more than an old saying.

Some form of appraisal of performance of men who are normally expected to assume greater responsibilities, either within present assignments or upon promotion, is part of a good program. There are a number of forms of appraisal.

¶ The essay type of rating
¶ The forced choice rating
¶ The field review report
¶ Professional interviews
¶ Critical incident rating
¶ Aptitude and psychological testing

The selection of the best method for a particular company requires careful study. Certainly the application of any of the methods should not be undertaken without the benefit of good counsel, particularly in the area of testing and interviewing.

The management life of any company is essential to its continuity. It is well worth insuring. The tools are available in the form of methods, skills, and techniques. All one needs to do is to use them. ▲▲



WYETH LABORATORIES BUILDING, CURRENTLY BEING BUILT AT RADNOR, PA., WILL HAVE PORCELAIN COATED PANELS.

More Than One Way to Skin a Building

CE exclusive

ROBERT K. POSEY, A.I.A., Associate Partner
Skidmore, Owings & Merrill, Architects-Engineers

Robert K. Posey received a B.S. degree in Architecture and a B.S. degree in Architectural Engineering at Alabama Polytechnic Institute, Auburn, Alabama, where he was elected to Tau Beta Pi. During World War II, he served on General Patton's Third Army Staff, in direct charge of protection and preservation of Europe's cultural treasures, including buildings, movable works of art, and scientific objects and data. For his service, France awarded him the Legion of Honor and Belgium awarded him the Order of Leopold. He is a practicing architect.

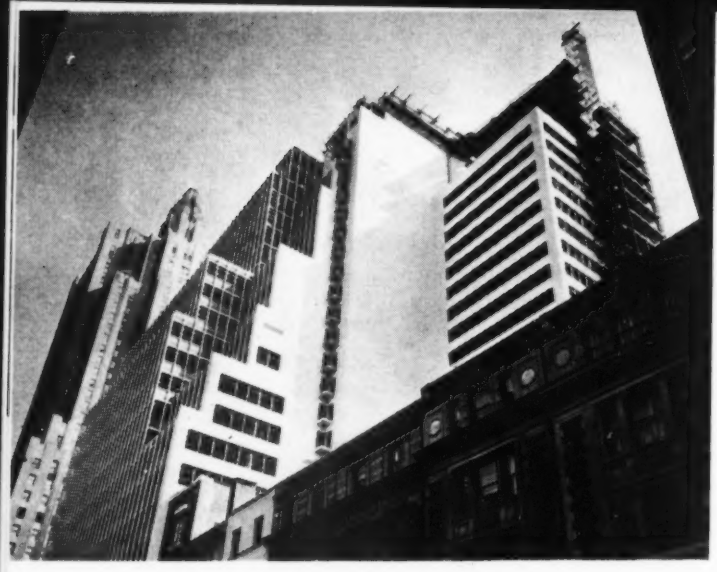
A FEW DAYS AGO, while at lunch with some friends, one of them remarked that architects now are re-examining recent departures in exterior surface treatment of buildings and are going back to the time-honored materials of stone and wood. He amplified his statement by saying that problems of glare and temperature control have shown glass and metal are not acceptable and must be discarded.

In view of current interest in the use of panel skins instead of walls*, this observation seemed surprising. My experience, based upon the result of many months of study of present applications and of effort to develop skins for use on buildings now under construction, indicates there is no set formula for exterior surface treatment.

Prior to 1900 the exterior load bearing wall was the accepted answer. Our architectural forms had been borrowed from the ancient Romans whose barrel vaults rested upon continuous heavy outside walls of masonry, and the wider the span the heavier the wall. Windows were incidental piercings of the mass. The designer was limited to the organizing and decorating of these perforations.

Architects of Athens had used exterior walls as screens set anywhere in a group of columns. Generally the columns themselves formed the extreme

*The words "skins" and "walls," in the common acceptance of their meaning, define basically opposing terms. Skin generally is taken to mean a thin outside covering shielding the inner structure, while a wall is thought of as a mass capable of supporting a load.



NEW URIS BROS. OFFICE BUILDING IN N. Y. WILL HAVE 3 ALUMINUM-AND-GLASS WALLS; 1 GLAZED BRICK WALL.

outside of the building. Later Gothic builders used decorative masonry and glass curtains between columns clusters designed to receive concentrated loads of lofty arched vaults. While both of these great architectural eras employed stone in the execution of these screens or skins, they do establish, somewhat heavily, a precedent for the nonload bearing exterior envelopes of today's buildings.

With the development of explosive military projectiles, the heavy masonry protective wall became obsolete. The old massive walls could resist swords, battering rams, and flaming arrows, but high velocity shells crashed into and knocked out the inner fortress. However, it was not until the first half of the present century that the introduction of a new structural material finally pushed out natural stone as a leading building medium. The new structural steel shape with its high tensile strength and superiority in compression could be made smaller when used as a column. Beams could be spaced further apart in a post and lintel arrangement, which is the simplest and most used form of construction.

An indirect factor favoring rapid development of the new medium was the appearance of well engineered machinery for the handling of structural materials. Power driven hoists, cranes, and derricks were free from man-power limitations.

The team of structural steel and handy erection devices soon caused engineers and architects to accept the challenge of building high into the air. The resulting skyscraper utilized the simple, easily built skeleton, and this called for a further search for lightweight, durable enclosing materials.

Glass the Forerunner

Glass was the first architectural material to answer this challenge. Through long usage engineers and architects knew glass. They knew of its dimensional stability, its beauty, and its practicability for use in large thin sheets. They knew that it could resist weather, and they applied it properly because they knew that brittleness was its greatest weakness.

Glass manufacturers soon improved their material and made it firm in its position as a vital material in a new mode of construction. They made it heat-absorbing so that it could offer a measure of thermal insulation. By textured surfacing and coloring they made it glare-reducing. It could be made into a mirror to reflect images, and it could be transparent, or opaque, or simply translucent. Its reflective quality could give a changeable play of light and shade that enlivened the surface of a building.

Buildings have been built that are glass skinned

BORDEN CO., CHEMICAL DIVISION, RESEARCH LABORATORY AT PHILADELPHIA, PA., HAS COOLITE WIRE GLASS EXTERIOR.

from top to bottom. Only thin metallic fastening members break the pattern. The architects proneness for organization shows itself in the carefully studied arrangement of these horizontal and vertical metal strips. At the window level the glass is transparent. In some designs even the spandrels are transparent glass with an opaque surface installed several inches behind to lend depth and to provide a subtle use of the reflective quality of glass.

Porcelain Coated Panels

The porcelain industry now is entering a strong competitor in the spandrel applications. Porcelain, which is glass in another form, adheres perfectly when fused onto surfaced steel sheets. Its possibilities as a building material long had been recognized, but for many years it had been imprisoned in the kitchen. More recently, because of good color possibilities, it had been utilized as surfacing for small business houses whose trade depended upon quick notice by passing motorists. These installations scarcely were dignified, and so porcelain on steel panels had not yet won high esteem among architects.

The material, however, is interesting and persistent. It retains many of the qualities of glass and, in body at least, it is not brittle. Its color is brilliant. Assuming good workmanship, it has a measure of that desired quality called "depth of color."

With a lamination technique borrowed from the aeroplane industry, sheet steel panels now can be made and held as flat as glass. Waviness, or lack of flatness, had been the greatest hindrance to the architectural acceptance of porcelain coated metal sheets as surfacing materials. A steel sheet deforms under the intense heat necessary for the fusion of a porcelain surfacing. Unless it is held rigidly flat it will regain the deformed shape even after being assembled into a panel. Lamination with a suitable core successfully holds the flatness.

The sheet to be porcelainized must be stretcher-leveled steel, of at least No. 16 gauge for a final panel of about 3 feet by 5 feet, and both sides must receive the fused porcelain coating. It then must be made to adhere to a core, which in turn is backed with a sheet of steel to maintain even stress. The core itself can take varied forms. An eggcrate or honeycomb of treated paper or aluminum presently is giving best results. For a 3 x 5-ft panel the aluminum honeycomb only need be ¼-in. thick. A paper honeycomb should be not less than 2-in. thick for best results.

To prevent delamination from moisture the adhesive material must be insoluble. Although much effort has been expended by the industry to seal the panel against moisture infiltration and various venting methods have been employed to minimize condensation, it is best to assume that water will be present in the panel. Thus, the panel should be capable of withstanding immersion, and it would follow that aluminum is a more permanent core than impregnated paper.

COFFERED ALUMINUM PANELS ON ALCOA BUILDING IN PITTSBURGH, PA., ARE BACKED BY PERLITE CONCRETE.

Since the surface of a building is exposed not only to rain but to all effects of weather, panel surfacing is subjected to freezing, to great heat, and to sudden variations between very hot and quite cool. These changing conditions will produce either positive or negative air pressure within the panels so the adhering agents must be strong, and the core must be flexible and elastic, to guard against delamination or permanent deformation. Interior ventilation must be provided to equalize quickly the air pressure variations as well as to minimize condensation.

Protection Against Weather

These problems concern the construction of the panel itself. In addition to being sound, however, a skin must protect sucessfully the building against weather. In order to repel water a panel needs to be nothing other than a sheet of glass. The weakest point of glazing is the material holding the glass into a supporting frame, whether wood or metal. In present day building construction this is accomplished generally by setting the glass in a compound that

is impervious to water and that will retain a high degree of adhesiveness and elasticity over a period of many years. With the brittleness of glass, and possible unevenness of pressure, a clamped gasket scheme of setting causes glass breakage on a scale large enough to become uneconomical.

On the other hand, metal panels can withstand great pressure applied to the edges with reasonable uniformity. As a result it is desirable and feasible to set a panel into a frame by means of a gasket held tightly by clamp-acting glazing heads. If the gasket is prefabricated to encompass the periphery of the panel and is applied in the shop, it can be received at the job ready to install with a minimum of field labor. One job, now under construction, utilizes a U-shaped Neoprene gasket vulcanized at the corners to form a continuous border around each panel. Installation is simple, direct, and economical.

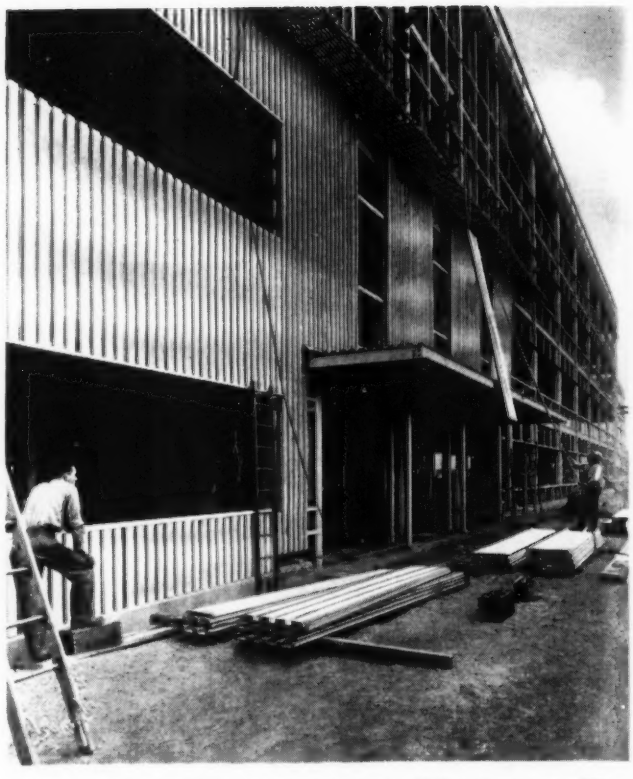
Insulation Important

Aside from shedding water a panel must keep out the heat or cold and must not load to excess reasonably engineered heating and air-conditioning systems. Today there are thermal insulations, such as mineral or glass wool, compressed fibres, reflecting surfaces, and expanded substances that equal in 2-in. thickness the insulating value of a 12-in. thick masonry wall. Since these materials are also light in weight it is entirely feasible to attach a 2-in. insulation blanket to the back of an aluminum honeycomb cored panel and still only have a maximum thickness of 2½ inches.

In many installations it is desirable to expose the inside of the panel. It then becomes necessary to protect or finish a soft insulation with a hard, paintable wearing surface. Many inexpensive materials can be used for this inside finish. Pressed composition board, ⅛-in. asbestos millboard, or thin sheet steel are available and can be used successfully.

Design considerations in applying insulating materials again involve the problem of condensation within the panel. Just as it is necessary to ventilate the honeycomb core and choose materials that are able to withstand moisture, the inside sandwich or insulation must be of a type that will not lose efficiency when moist. Foamglas, which is composed of a multiplicity of moisture tight air cells, could be chosen as one of the better insulation mediums.

Adding together these criteria, good panel construction would have a face of No. 16-gauge stretcher-leveled steel, porcelain enameled on both sides. The sheet would be laminated thermally to a ¼-in. aluminum honeycomb, which in turn would be backed by and laminated to a No. 24-gauge galvanized sheet of steel. A 2-in. thickness of Foamglas would be cemented to this galvanized sheet and then the whole protected on the room side by a No. 18-gauge electro-galvanized steel sheet prepared to grip paint. The inner steel would form a



STAINLESS STEEL PANEL IS HOISTED INTO PLACE ON G. E. TURBINE BUILDING IN SCHENECTADY, N. Y.

pan slightly smaller in size than the honeycombed section so the resulting border flanges could be set into the holding frame as though the panel were a sheet of glass. This setting scheme permits the use of a continuous extrusion for window and spandrel in sealed skins not complicated by openable sash.

If the panel manufacturer chooses a paper instead of an aluminum honeycomb core, the construction becomes somewhat different. The core itself must be not less than 2-in. thick. Thus, the over-all panel depth increases to 4 inches, if the core and insulation are separate and there are three layers of metal. One alternative is to fill the paper honeycomb with an insulating material to eliminate one sheet of steel, making a 2-in. thick panel. This is satisfactory insofar as flatness is concerned. These materials, however, being poorly ventilated, could become saturated with condensation moisture. If such a condition were to occur, the paper core and the laminating glue would be subject to continuous wetness and the inner disintegration hazard would be magnified.

Solid core panels of asbestos board or rigid insulation have been used where lower cost is of prime importance. Neither material has produced a flatness equal to the honeycomb core, and delamination is more probable. Unless a panel is flat and free from warpage it is not recommendable for architectural use. Excessive stressing of low cost on a new building is foolish if the desired appearance, though attained initially, cannot be maintained.

At present there are several excellent insulated,

ARCHITECT'S RENDERING IS PREVIEW OF STAINLESS STEEL SHEATHED SOCONY VACUUM BUILDING.

but not porcelain enameled, metal panels commercially available. All of them have adapted some form of corrugation to render unnoticeable the lack of flatness. This also permits greater lengths than are advisable in flat porcelainized panels. The corrugation generally is turned to the weather, and the inside is a flush type surface appearing very similar to standard interior movable metal partitions. The metal employed may be aluminum, stainless steel, or paint grip steel sheets. These panels are economical, light in weight, and their speed of erection is excellent. For these reasons they will continue to find widespread use in industrial buildings. They do not, however, have the finished quality of glass or porcelain enameled panels and so will find limited use in finer architectural applications.

Utilitarian Skins

Contrasted to panels affording outside and inside finish together with thermal insulation are the long used, purely utilitarian skins of corrugated cement asbestos and parallel-corrugated prefinished steel. These materials find their greatest use in industrial structures where temperature control is of secondary importance. They do a fine job of keeping out the rain, and they lay no claim to sophistication. No excuses need to be made for these rugged materials for they securely hold their market.

A distant cousin of the one-layer skin systems is the coffered aluminum surfacing first developed for the Alcoa Building in Pittsburgh. This system is not a complete exterior wall within itself but is, instead, a thin outer layer of finish material applied over a purely utilitarian backup of masonry or cement blown onto previously erected steel mesh.

The principal design feature of this waffle-like skin is that it is deliberately preformed or distorted so that comparatively thin sheet aluminum can be used and yet achieve a reasonably flat appearance. Although several major buildings have this exterior none of them entirely satisfy the more esthetic architects. The waviness of thin metal can be seen so a great deal of the material's richness is lost.

If some persons seem to think this type of skin is lacking in appearance, it is nevertheless a fabulous aid to erection speed. This is of great importance in modern construction. Because it is prefabricated readily and is light enough to be handled easily on the job, a large skyscraper can be enclosed in a single work week. This happy facility makes for minimum temporary enclosure requirements resulting in considerable cost reduction at the job site.

Looking Ahead

Of all the materials available, in my opinion the leader in brilliance and beauty is glass. Its naturalness and glossy sheen plus the fact that it can withstand most atmospheric impurities are important characteristics. It can be kept clean with a minimum of effort. Two men can wash the 22-story all-glass Lever House, in New York, from top to bottom in 2 days. In contrast, it is much too costly to clean neighboring masonry buildings more than once in 10 years, so they generally appear drab and sooty.

Second in architectural acceptability stands the porcelain covered steel panel. The General Motors Technical Research Center, near Detroit, has successfully employed this material. Panel manufacturers are to be congratulated upon the rapid development of their product, and their sympathetic acceptance of architectural thinking that frequently might seem too concerned with appearance.

The less architectural and more specifically utilitarian panels will continue to find ample use in commercial and industrial work for which they are suited. Cement-asbestos insulated sandwich panels are commercially available. Textured surface spandrel panels of stainless steel and other more costly materials are being developed and applied. Marble, thin cut stone, and finer faced brick will find use as decorative spandrel surfacing if not as over-all skins.

Whatever its form, the dry constructed skin is a natural outgrowth of skeleton framing and prefabrication—the trend in building today. This basic departure is in entire harmony with the concept of a sealed envelope for an air conditioned, artificially lighted structure. Lightness and color inspire and challenge the designer. With the mood established we can expect rapid development into a new and gayer building period. ▲▲

ARTIST SKETCH OF NATION'S FIRST CENTRAL STATION NUCLEAR POWER PLANT BEING BUILT AT SHIPPINGPORT, PA.

Consultants and Atomic Power

PHILIP D. BUSH, Acting Manager,
Atomic Energy Division, Kaiser Engineers

CE exclusive

P. D. Bush is a chemical engineer with B.S. in Electro-Chemical Engineering from Stanford University and an M.S. in Metallurgy from MIT. He went with the Kaiser organization in 1942 as operations and construction progress engineer for various plant units of the Fontana steel mill. He reported to the vice president on matters regarding technical and administrative advice, cost analysis, forecasting of personnel, raw materials, and financial requirements of steel facilities. He became assistant superintendent of Open Hearth Furnaces in 1945.

He was transferred in 1947 to Kaiser Engineers with responsibility for metallurgical problems, economic forecasts, and analysis of operations and costs of client firms. Since 1948 he has been in charge of air pollution work for steel mills, aluminum, and cement plants. He was assigned to his present position in 1953.

WHY DOES A FIRM that has been kept busy on the engineering and construction of conventional plants for industry want to spend money now in order to participate in the future of atomic energy?

Our prime reason for being in any business is to make a profit, and we think there will be plenty of profitable atomic energy business in the future. Fundamentally, the types of problems are similar to those that had to be solved in the aluminum, cement, gypsum, petroleum, power, and steel industries; those problems were basically mechanical, electrical, chemical, and metallurgical in nature. Therefore, if an engineering and construction firm believes that atomic energy will constitute a significant portion of an expanding economy, then the logical recourse is to obtain as much knowledge and experience as possible in the immediate future.

Engineering consultants will have to advise clients on the use of such exotic things as electromagnetic pumps, high density concretes, completely leak-proof valves and welds, zirconium claddings, and air pollution involving concentrations of a millionth of a millionth of a grain per cubic foot. Such is the world of atomic energy. However, this same world

also includes conventional pumps and valves, standard heat exchangers, regular redwood cooling towers, stock overhead traveling cranes, and concrete of normal density.

The Problem of Fuel Reserves

The problem of the world fuel reserves will become more acute each year if we assume that both population and standard of living will continue to rise. In many parts of the world, the question is not the cost of power, but simply whether it is available at all. I think nothing points to this situation more vividly than the fact that one of the largest aluminum companies in the world has to transport its raw material 6000 miles from the West Indies to British Columbia in order to obtain power in sufficient quantity to reduce the alumina; the pig aluminum must, in turn, be shipped thousands of miles for remelting and fabrication into consumer products. The question is not whether it is worth the trouble, for surely the aluminum company would not have built its reduction plant in British Columbia if it did not look like a profitable venture; the question is how much farther afield must the next reduction plant be built in order to obtain a sufficiently permanent power supply that would yield pig at a competitive cost.

Nuclear power is a favorite topic of conversation and controversy. We feel that nuclear power must shortly contribute a significant amount of the total power used by the United States, and more particularly, the rest of the world. We agree with the consensus of most students of the world's energy problems that fossil fuels are not in sufficient reserve to support the continued increase in our standard of living for very many more decades. Furthermore, there are those who believe that coal, gas, and oil are too valuable as chemicals to be burned as fuels if alternate fuels can be found. It is quite probable that both theses—that of diminishing reserves, and that of preferred value as chemical raw materials—will be satisfied by the development of practical use of atomic energy in this ensuing half-century and if we take a look into the more distant future, the practical use of solar energy in the next century.

Increasing Population — Decreasing Fuel Reserves

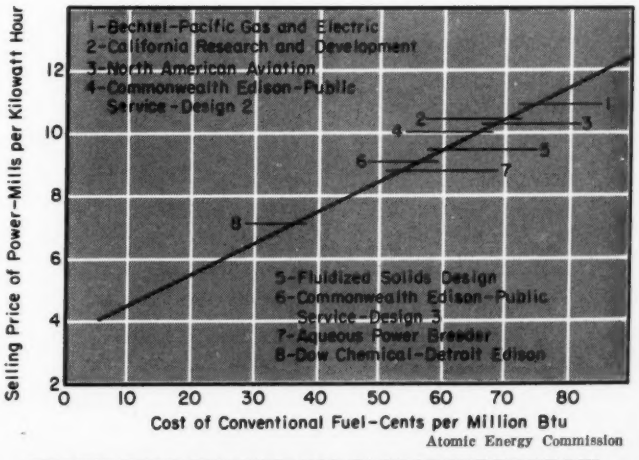
In a discussion of this kind, it would be highly unfashionable to omit some specific data on the specter of increased population, higher energy use per capita, and diminishing fuel reserves. If you will assume: first, that the present birth rate will decrease slightly during the next 20 years; second, that the birth rate will drop to a level approximately 20 percent below the current rate after 1975; third, that the death rate will continue to decline (but only half as rapidly as during the past 25 years); and fourth, immigration will continue at a rate of 200,000 per year—then the United States population will be:

1955.....164 million
1970.....206 million
2000.....308 million

Simultaneous with the rising population, there will be an increase in per capita use of energy. If we assume a continued increase in per capita energy consumption at the same rate as that experienced during the last 20 years in the United States, it appears that by the year 2000 (only 45 years away) all of our U.S. conventional fuel sources, recoverable at 1.3 times the 1950 real cost, will have been essentially exhausted unless imports become tremendously more significant than at present. The above analysis is based on a much more conservative approach than that appearing in the majority of studies of this kind, as it gives full weight to the period 1930-40, when the rate of economic growth of the United States was relatively low.

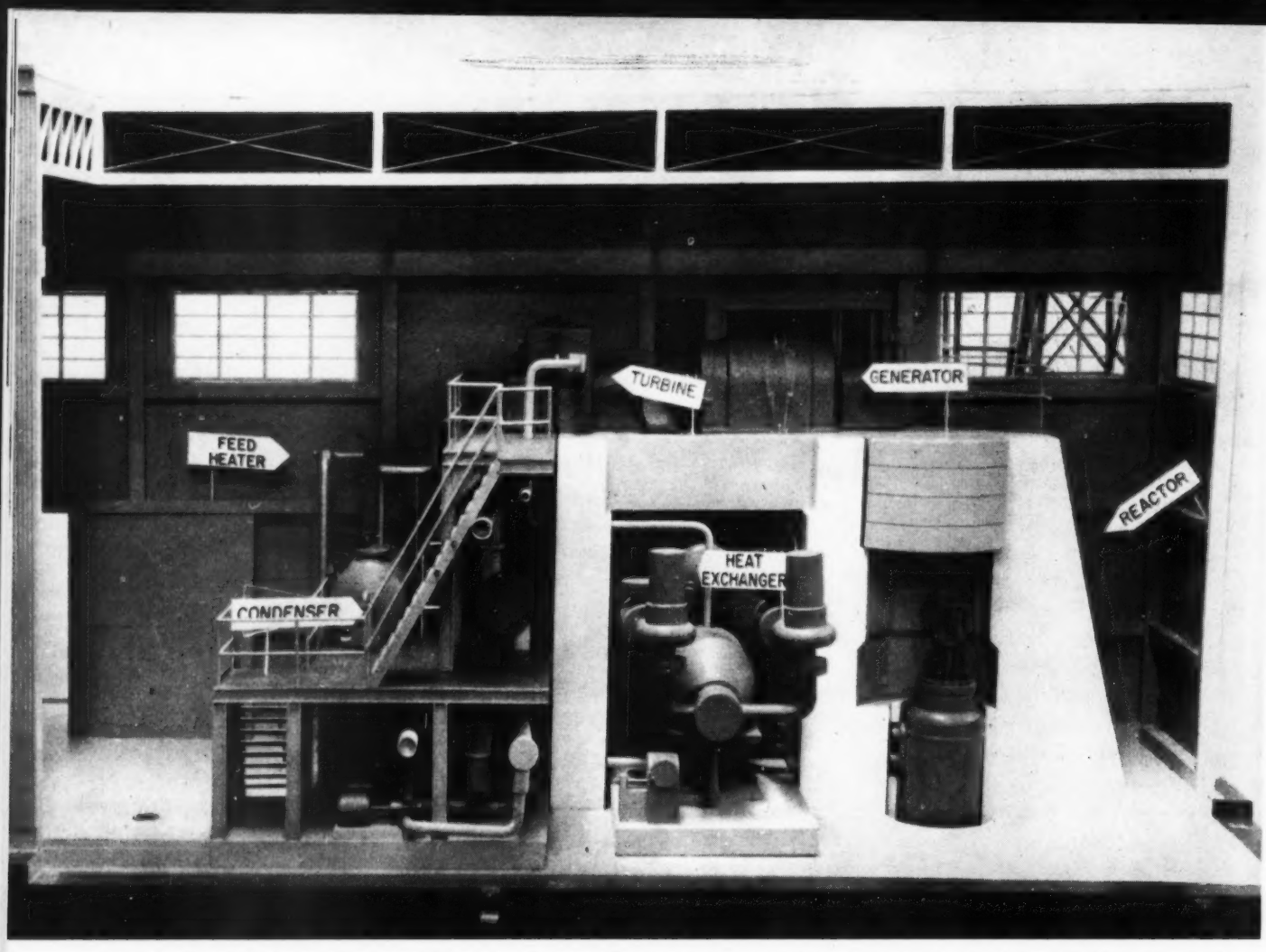
In 1949, Palmer Putnam was commissioned to make a study of the maximum plausible world demands for energy over the next 50 to 100 years; his work, published in 1953, appears to be the most recent of comprehensive studies of this nature. His estimates of proven and unproven fossil fuel reserves were based on those that could be recovered at no more than 1.3 times the 1950 real unit costs for oil and gas and at no more than twice the 1950 real unit costs for coal. While accepting Putnam's 1.3 factor for oil and gas recovery costs, we believe that the coal reserves also should be adjusted downward to those recoverable at 1.3 times the 1950 costs. The reasoning behind this is that coal will constitute the primary source of fossil fuel energy in years to come and 50 percent of those coal reserves lie west of the Mississippi River. Thus, even if the cost of recovering coal from the ground did not rise above the 1950 real unit costs, transportation to Eastern markets would double the cost of coal.

Taking this reasoning one step further, the cost



Atomic Energy Commission

SELLING PRICE OF POWER FOR EACH OF THE EIGHT DIFFERENT NUCLEAR POWER REACTOR DESIGNS SHOWN.



MODEL OF ARMY'S POWER REACTOR, 2000 KW CAPACITY, TO BE BUILT AND OPERATED AT FORT BELVOIR, VIRGINIA.

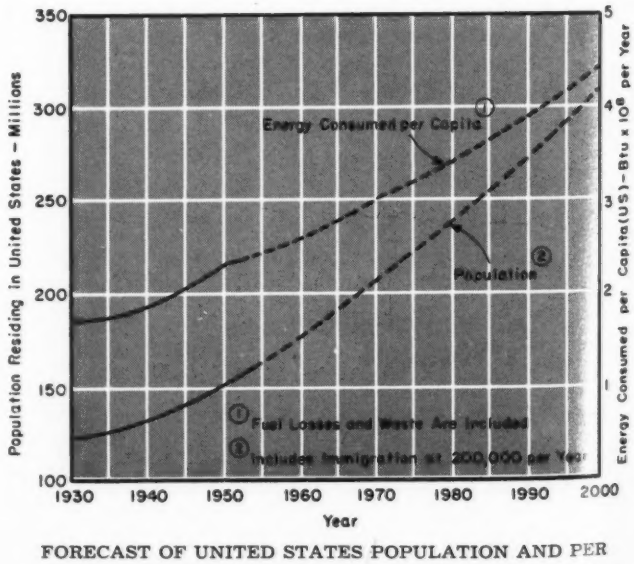
of coal as fuel for electrical energy plants is approximately 3.5 mills per kwh. If this cost were doubled in order to utilize more reserves, then increases in power costs (all other things being stable) would be 3.5 mills per kwh. This would be of considerable significance, because average total power generation costs today are 6.5 mills per kwh.

An estimated total energy of 4.0×10^{18} Btu could be obtained from proven and unproven reserves of fossil fuels recoverable at no more than 1.3 times 1950 real unit costs. The breakdown would show:

Estimate of United States Fuel Reserves in 1950	
Coal	3.1×10^{18} Btu
Oil and Gas	0.5×10^{18} Btu
Oil Shale	0.4×10^{18} Btu
Total	4.0×10^{18} Btu

This includes proven and unproven reserves recoverable at less than 1.3 times 1950 unit costs.

True, it would be possible to import great quantities of fuel in the same way we now import oil, but I shudder to think of the transportation problem and the military security aspects for a nation of 300 million people without economically recoverable fuel reserves. If we take any other position in this matter, such as a lower rate of per capita energy consumption, or more importation of fuel during the next half century, or recovery of higher-cost reserves, it can be only at the expense of the continued improvement in our standard of living. Additionally, we have no assurance that the seemingly limitless sources of foreign oil will be available to us in any given quantities at current prices; it is probable that prices will be bid up considerably by



FORECAST OF UNITED STATES POPULATION AND PER CAPITA ENERGY CONSUMPTION THROUGH YEAR 2000.

a fuel-hungry world awakening to the benefits to be derived from fuel energy rather than human energy. An example today is Brazil, which imports almost 20 percent of its fuel requirements and is far from being industrialized.

I have outlined briefly the United States energy-and-population problem. A similar analysis made for the world would show an even more serious picture of increasing population, increased per capita use of energy, and diminishing sources of energy. One cannot wait until the partial depletion of some reserves, which most assuredly will come by 1975 in some areas, and then suddenly acquire a new technology utilizing something other than coal, gas, or oil as fuel.

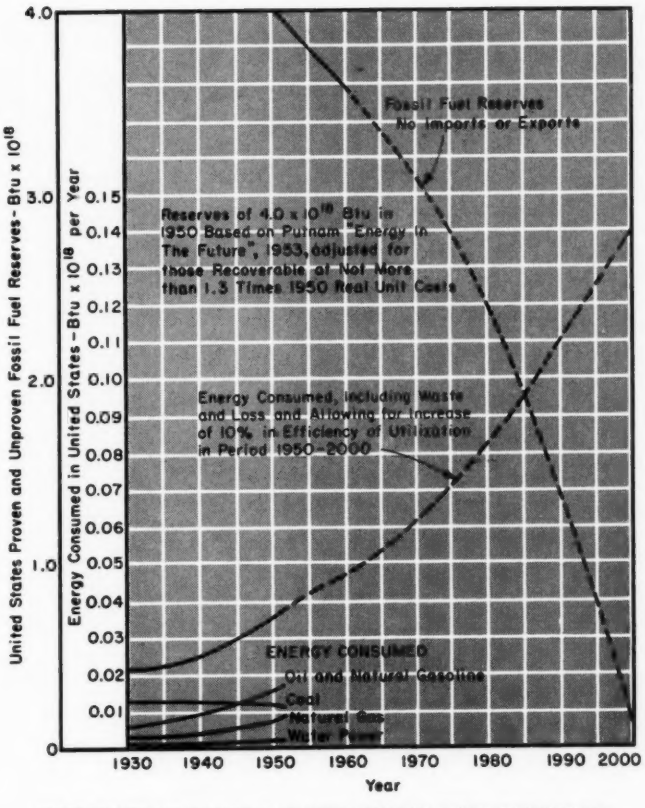
Fortunately for this nation and the world, the energy available from economically recoverable uranium and thorium probably amounts to at least 20 times that recoverable from the world's supply of conventional fuels. It is then, during those periods when engineers are allowed to dream, that we conclude nuclear energy must bridge the gap between today's use of coal, gas, and oil and a time when solar energy must be put to practical use. Right here and now we must develop the technology of obtaining useful power from nuclear energy, making it so economical that it can compete with conventional fuels within the next decade. If all astute businessmen were equally astute statesmen, it is conceivable that they would say "competitive or not, we must use atomic energy now and husband our fossil fuels in order to stretch out the period of availability." Unfortunately, however, even if all businessmen were astute statesmen, the majority of their stockholders are not. They still are understandably interested in the dividends being paid out of today's profits.

The Principal Challenge

As I see it, the principal challenge is not the technical feasibility of nuclear power (because that has already been proven for several reactor types), but its economic feasibility in today's fuel market, so that our standard of living will not be jeopardized either by the creeping cost of conventional fuels as they become more remote or difficult to recover or by the husbanding of conventional fuels from the standpoint of national security. This complex problem of natural resources and competitive nuclear power represents atomic energy's principal challenge to today's engineers.

In any event, if the management of an engineering company agrees that atomic energy will be required as a significant source of power, then this same management should begin acquiring the knowledge necessary to evaluate critically the most promising of the various reactor types that have been developed or are worthy of development.

It took more than one hundred years to develop



FORECAST OF UNITED STATES FOSSIL FUEL RESERVES THROUGH 2000 AND CURVES OF ENERGY CONSUMED.

the steam power plant and combustion equipment to its present state. There was profit for engineering and equipment companies all during the time that these improvements were being effected; so, we believe, will it be with nuclear power, as soon as the preliminary period of the next three to five years has passed. We consider this extremely short, unprofitable period as normal development expense for a profitable future.

Early in the lifetime of some of the older readers, it took 10 lbs of coal to generate 1 useful kilowatt hour. Today it takes less than 1 lb of coal to generate 1 kilowatt hour. We are at a loss to know why there is so much pessimism about making nuclear power competitive with conventional fuels.

I believe that the high estimates of cost for nuclear power stem from the conservatism of the estimators in figuring the capital cost of nuclear power plants which have yet to go through detailed design and construction. Their conservatism is warranted because of the necessity of covering the cost of items with which there is no related experience or for which completed designs have not been made. With the actual operation of a nuclear-powered submarine; the imminent operation of another nuclear-powered submarine as well as a commercial power plant at Shippingport, Pennsylvania; and the authorization to proceed with construction of the medium-size plants, utilizing four different reactor design concepts (boiling water, homogeneous, sodi-

um-graphite, and fast breeder), the estimators will soon have actual costs with which to work. Only then can many of the extraordinary safety and security features incorporated in current conceptual designs be reduced in cost, and that necessary evil, contingency, be reduced substantially. I mention these cost problems, not because we think the future of nuclear power plants throughout the world depends on their solution to the extent that recent publicity has indicated, but only to show why we believe that economically competitive nuclear power may not be possible, at least for the next 5 years, in most areas of the United States. But will nuclear power have to be competitive with 6-mill steam power in certain heavily populated areas of the United States, with 8-mill power in other U.S. locations, or with the quite different situation in still other areas of the world where the need for power is desperate and there is no fuel or falling water at all?

When one realizes that the capital cost of a nuclear power plant may be twice that of a conventional plant, and that many of the principal components must run with essentially no maintenance, one will admit that it takes a few years of development and experience on the part of both the engineer and the equipment manufacturer to keep these cost items under control. By being involved in nuclear engineering and construction now, Kaiser Engineers will be in a position to offer greater experience and service in the future.

Package Power Plants

Most of the discussion centering around power plants is concerned with what might be termed central station power plants of at least 60,000-kw capacity. However, there is a tremendous potential business in the design and installation of what may be termed "package power plants." Most of these plants would probably be in the range of 3000 to 30,000-kw capacity. Generally, the cost of power is not the primary factor in the selection of this type of plant; it is simply a question of getting power in a remote location or in circumstances where the logistics of fuel supply are difficult. The Army Package Power Project, which has been awarded and is under way, is a plant of approximately 2000-kw capacity. It will be built and operated at Fort Belvoir, Virginia, only 18 miles from Washington, D. C., and it is to serve as a prototype for future power plants of essentially the same capacity.

In the United States we seldom think of constructing a 2000-kw, or even a 10,000-kw, power plant, because the consuming capacity of a region is sufficient to warrant a central station plant of considerably greater capacity. However, there are small, isolated communities or remote mining operations where a small nuclear power plant would be useful because the weather or difficult terrain makes it virtually impossible to supply fuel to a conventional power plant in those locations. In these instances, we are not talking about cheap power, but power costing between one and three cents per kilowatt-hour. Studies made by our firm on package power plants, using nuclear fuels, show that competitive nuclear power is as likely in a plant of this size as in the large central station plants.

Considering the costly contingency and safety provisions on nuclear power plants yet to be operated, it is interesting to note that the portion of the plant where nuclear energy is involved might account for 25 percent of the total cost of design, installation, and the pre-operating tests. Then, why did the bids range all the way from 2.1 million to 6.9 million dollars in the recent fixed-price proposals to the Atomic Energy Commission for the Army Package Power Reactor? All other things being reasonably equal, the contingencies must have worried some of the bidders considerably more than others. Certainly construction and operating cost data will become available after the contractor has completed his assignment. Will not future bids, then, be more closely bunched and probably lower?

Kaiser Engineers feel that there is a good market for this type of unit operating at approximately the 5000-kw level. If a conventional power plant of this capacity were operating on fuel oil in a remote region or in an under-developed area, the fuel oil consumption would be 75,000 bbls per year — equivalent to 350 cargo-plane loads. For this same plant operating on enriched uranium, the fuel supply problem would involve 1500 pounds of uranium fuel elements shipped in once every three years. This means that there should be a vast potential of small, widely scattered communities where package nuclear power plants would be competitive now.

Responsibility of the Profession

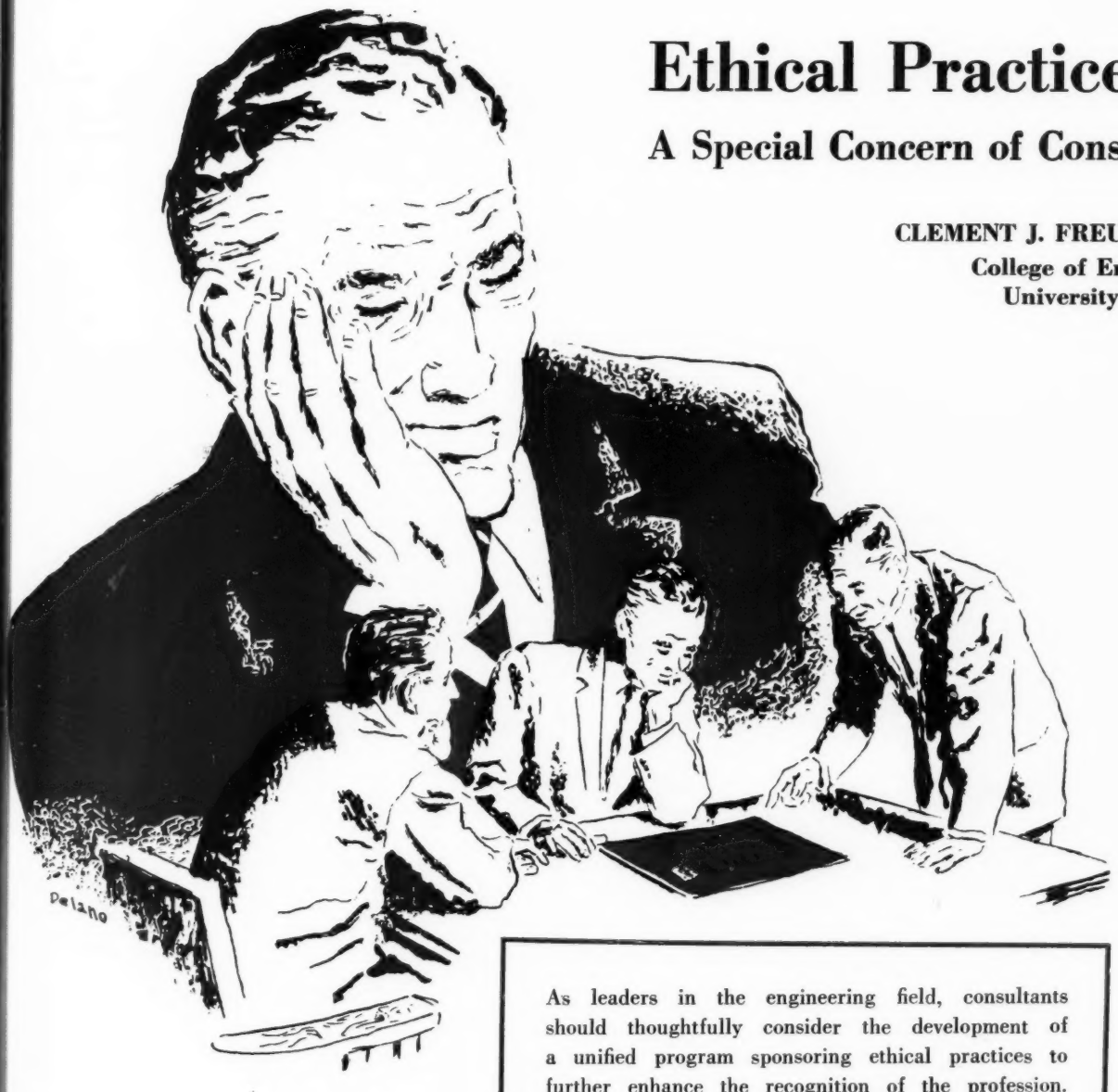
Kaiser Engineers feels that the engineering profession has the responsibility of keeping abreast of fundamental research in the peacetime application of nuclear energy. It is the profession's further responsibility to translate this research into engineering design, construction, and operation. Most power plant clients in the future will be divided into two categories; those who simply want more power using any fuel, and those who know ahead of time that they want some kind of nuclear power, but are not sure what type of reactor will yield the lowest over-all power cost. A progressive engineering firm must be aware of changes in the supply of various fuels, including nuclear fuels, and be able to evaluate, design, and construct the various types of nuclear power plants.

In accordance with the above thinking, Kaiser Engineers, in establishing an Atomic Energy Division, is spending a substantial sum on the study of the technical and economic feasibility of various types of plants for nuclear power. ▲▲

Ethical Practices...

A Special Concern of Consultants

CLEMENT J. FREUND, Dean
College of Engineering
University of Detroit



As leaders in the engineering field, consultants should thoughtfully consider the development of a unified program sponsoring ethical practices to further enhance the recognition of the profession.

Clement J. Freund graduated from Campion College in 1916 with an A.B. degree, and following U.S. Army service during World War I, he received his M.E. degree from Marquette University in 1922. He then worked in various capacities with the Falk Corporation — a company he still serves as a consultant — until assuming his present position as Dean of the College of Engineering at the University of Detroit, over 20 years ago.

Extremely active in society affairs, Mr. Freund is a Fellow in ASME, a past president of the American Society for Engineering Education, and a member of Pi Tau Sigma. He has served on the National Council of Tau Beta Pi, the committee on Engineering and Allied Technical Professions of the American Engineering Council, the Committee of Ethics of Engineers' Council for Professional Development, and both the Governor's Seaway Commission and the Architect's Professional Engineers' and Land Surveyors' Committee on Registration for the State of Michigan.

THE CONSULTING ENGINEER is clearly a professional practitioner. People may argue about other engineers, but they always recognize the consultant as truly professional. He possesses superior, specialized knowledge and competence, and he makes use of these attributes to serve his fellow man. Professional service has been called "ministry to the people."

Not only consulting engineers serve the people; every professional engineer does. But most engineers serve the people indirectly. Think of the engineer who balanced the moving parts of one of the new, eight-cylinder automobile engines. Thousands of men and women depend upon those engines to get them where they want to go. Yet, few of them ever thought of the engineer or heard about dynamic balancing as related to their automobile.

The consulting engineer, on the other hand, serves his clients directly and personally. People can appre-

ciate his efforts even when they know nothing about thermodynamics, hydraulics, metallurgy, or any of the other fundamentals of engineering. He serves his clients much as the physician ministers personally and directly to his patients.

A technically competent engineer could be a swindler — and might be recognized as such. But the consulting engineer must be known for his integrity as well as his technical ability. To uphold a reputation for integrity, he needs to subscribe to a professional code of ethics, and more importantly, he has to be conscientious about living up to that code. Technical competence alone is not enough.

I am thinking about a County Board that retains a consulting engineer to design and supervise the construction of a pumping station for water supply. The board is made up of several farmers, two or three merchants, a banker, a lawyer, and a crossroads gas station operator. None of them knows anything about pumping stations or engineering. They are at the mercy of the engineer. He has to be ethical or they could not entrust him with the job and $540,000 they have appropriated.

A Community Problem

Ethical principles are not a completely personal responsibility of the individual consulting engineer. No consultant could keep up his standing as an ethical practitioner without the help of his fellows. The whole fraternity of consulting engineers must remain closely associated in a vigorous and perpetual campaign to preserve and advance engineering ethics. Professionalism does not thrive by itself; it must be constantly and painstakingly cultivated. The reputation for integrity of any one consulting engineer depends almost as much on the ethical standards of the entire brotherhood of consulting engineers as it does upon himself.

On an individual basis, the consulting engineer owes it to himself, and to his fellow consultants, to give his time and money to uphold engineering ethics. Even without a system of engineering ethics, employed engineers could undoubtedly continue in their jobs and make some sort of living as routine workers. But without ethics the consulting engineer would experience serious difficulties.

Consultants Are Leaders

In his famous "Second Mile," William Wickenden wrote that a characteristic of a professional man "... is a conscious recognition of social duty to be fulfilled among other things by guarding the ideals and standards of one's profession, by advancing it in public understanding and esteem, by sharing advances in technical knowledge, and by rendering gratuitous public service ..."

Among engineering professionals, consultants seem to take naturally to such leadership. Not every engineering leader is a consulting engineer, nor is every consulting engineer a leader. But if you actually counted them, you would find that in proportion to numbers, the few thousand American consulting engineers are much better represented among the leaders than the hundreds of thousands of employed engineers.

Leadership here means influence in the affairs of the profession. It is not a question of superior competence and distinction in water power, electronic applications, soil mechanics, or any other technical specialty. Rather, leadership means to be an officer or an important committeeman in an engineering society; to be spokesman for the profession to the citizens in the community, the state, or the nation; and to be among the few who meet to ponder and decide major professional issues. The names of McBryde, Westcott, Todd, Snelling, and Wallace come to mind in the field of mechanical engineering alone although there are others who are just as eminent.

How to Exert Leadership

Since his fellows have exalted the consulting engineer and have entrusted him with the management of their professional affairs, how should he exert himself for them and for the public? He might begin by persuading engineers to do more about ethics than shrug their shoulders. He could show them that ethical principles are the key to their professional status; to recognition of their status by the public; and to the improvement of their "ministry to the people." These are things most engineers don't know — or at least don't think about.

However, properly indoctrinating the thousands of engineers who have never even heard about codes of ethics will require united action by consulting engineers. All of them must agree upon a plan, and a few will have to give up their pet schemes or opinions in order to adjust to the majority. The following suggestions may help in formulating a program.

Courses of Action

¶ Consulting engineers might make it their business constantly to keep their clients and visitors thinking about ethics. They might carry notices or mottoes on their letterheads, agreements, contracts, and other standard documents, to explain that they adhere to the Code of Ethics of the American Institute of Consulting Engineers, or the Canons of Engineers' Council for Professional Development, or some other appropriate standard.

Copies of their particular standard could be placed in prominent positions in their waiting rooms or outer offices. This would redouble the visitors' respect for the engineering profession, and for the particular engineer. They would be inclined to have confidence in him.

¶ If they can qualify, consulting engineers should become members of the American Institute of Consulting Engineers and should support its program. This

is especially important because one of the objectives of the Institute is "to promote ethical principles and practices in the engineering profession."

¶ As individuals, the consultants themselves must be familiar with the Canons of the Engineers' Council for Professional Development, and the standards of the societies of which they are members. They must discipline themselves strictly to comply with these codes. Then they can instruct the young men whom they hire, guide their deportment, and thereby make them thoroughly and enthusiastically advocates of high ethical standards.

¶ Most consulting engineers belong to the National Society of Professional Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Society of Civil Engineers, or to some other national society. Many of them belong to several societies. Since they often have a strong voice in these organizations, they can suggest to the society boards and councils, officers, program makers and editors: "We ought to give professional ethics more of a play in our meeting programs and in our journals. Do you realize that it is long years since we have had a paper or an address on ethics presented at our annual convention or written-up in our publications?"

UNDERSTANDING AND ADHERING TO A CODE OF ETHICS WILL PROVIDE SELF SATISFACTION PLUS COMMUNITY RESPECT FOR THE ENTIRE ENGINEERING PROFESSION.

When appropriate, consulting engineers also can raise questions about ethical practice during the open discussions following the presentation of papers at engineering society meetings. They can discuss ethics when they visit with society members at luncheons and dinners, and in the corridors and lobbies. When society members constantly hear talk about ethics, they will realize it is a serious issue.

¶ Besides informal discussions, consultants can prepare papers on topics associated with ethics and present them before sessions of the national engineering societies. However, when they do, they must be careful not to "preach to the converted." It is an American habit to deliver stirring orations on controversial subjects before audiences that are completely and enthusiastically in agreement with the speaker. Business men praise free enterprise before the National Association of Manufacturers instead of socialist clubs or societies. Publicists urge civic pride and co-operation before chambers of commerce. Walter Reuther talks up unionism before the annual convention of the CIO.

If he can possibly contrive it, the consulting engineer should appear before those groups in the societies that (though exemplary in personal conduct) have not paid much attention to ethics as a philosophy. These members may be engineers who are deeply immersed in electronic controls, vibrations, fluid flow and the like, but have had little time to think about ethical questions and, unfortunately, have had still less inclination.

At first, committeemen and program chairmen may fight shy of proposals for sessions on ethics: "Nobody will come; engineers aren't interested in that sort of thing." Of course they won't come to hear dry philosophy and abstractions. The consulting engineer will have to devote his address to something like actual problems in ethics, such as those published in the 1949 issue of the *Constitution and By-Laws* of the American Institute of Consulting Engineers. He should tell them about the case of "the engineer who accepted a fee of $10,000 from a holding company without knowing that . . ." He should ask his audience, "What would you have done if you had been in that engineer's shoes?" He is sure to put on a lively session, and arouse much interest. There will be demands for more meetings on ethics.

Professional Ideals

If consulting engineers, and other engineers, succeed in setting up ethics as a principal feature of their professional life, and if they can make it clear to the public that ethics is a principal feature, they may finally achieve ideals to which the engineering profession has aspired for a hundred years. Vannevar Bush spoke about those ideals in his famous address before the American Engineering Council in 1939: "Will engineers go along heartily in developing a professional consciousness, a code of action, a philosophy which implements a desire to be a truly professional group, oriented primarily toward the advancement of the public health, safety, comfort, and progress? Will they accept as the central theme the engineer's ministration to society without fear of any class and without prejudice toward or away from any special social interests or causes?" ▲▲

CE exclusive

C. E. EVANSON
President and General Manager
T.A.B. Engineers, Inc.

Your Stake in Automation

C. E. Evanson is President and General Manager of T.A.B. Engineers, Inc., Chicago consulting firm, which has been designing and building Automation Production Systems since the close of the War. He is the originator of an Automation Rating Chart which assists executives to evaluate and plan for automation.

A graduate of Illinois Institute of Technology (B.S.M.E.) Evanson was formerly Plant Processing Engineer, Dole Valve Co.; Production Engineer, Prismacolor, Inc.; Assistant Chief Tool Engineer, Link Belt Ordnance; and Assistant Sales Manager, Barnes & Reinecke, Inc.

Evanson is a member of the American Society of Mechanical Engineers, the Society of American Military Engineers and the American Society of Tool Engineers.

SOME CONSULTING ENGINEERS have already contributed to the evolution of automation, but all will find it necessary to adjust to a new way of thinking to serve their clients properly in the years ahead. Automation is here today and growing fast. Some companies already have it, others are thinking about it, and still others need to be informed.

Because of the breadth and depth of the subject, individual manufacturers are understandably confused and apprehensive of automation for their own operations. Some of the questions that we have been asked are typical of the general thinking. Will automation pay for itself? Who is using automation in my industry? What is automation? What are its advantages? What does automation cost? What is the best way to get started? The most difficult question is, "How can I tell if I am ready for it?"

Perhaps your clients have asked similar questions. You, the consulting engineer, must have the answers to those questions.

Before you can determine whether a client is ready for automation, it is important that you have an understanding of the subject, that you understand something of its history, and that you appreciate its future potentials as well as its present day significance.

First, what is automation? Automation is not mechanization; it is not electronics; it is not super production. Actually, it is a manufacturing concept that combines electronic, electrical, and mechanical devices to produce and control automatically the manufacture of products. High speed production, electronic controls, feed-back circuits, conveying systems, automatic scales, and packaging machinery are all important components.

Is this more than the mechanization era that we have been in for two hundred years? The answer is quite simple. It is predicated upon the difference between mechanization and automation. Mechanization is use of machinery and equipment to replace manual labor or to assist manual labor in doing more work with less physical effort. Automation is a concept that goes one step farther to include the substitution of automatic controls for human judgment on the production line. Just as mechanization increases physical production per worker, automation permits greater productive thinking per worker. Mechanization reduced or eliminated the heavy arduous manual effort; automation reduces or eliminates human errors and takes the guess-work out of testing, inspection, and quality control.

Automation is an amalgamation of the thinking of many types of industrial geniuses during the past two centuries. For example, in 1783, Evans, using conveyors to aid production, built an "Automatic Flour Mill". Soon after, Eli Whitney, in the manufacture of muskets, developed the concept of piece-parts standardization and the interchangeability of parts. Ford subsequently contributed his genius when he recognized the possibilities of the packing house production line technique and adapted it to the manufacture of automobiles. Others have, of course, added their important contributions.

A natural sequel to mechanization was the rapid growth of electronics, stimulated during World War II. Developments since the close of the War now make it possible to program and control plant operations on the basis of data compiled and recorded automatically. Electronic computers have taken much of the labor out of mathematics, and combined with the electrically controlled, mechanized production line, they are leading to the elimination of practically all hand work and important on-the-production-line decisions.

The rising cost of manufacture, the higher standard of living, and the increased customer acceptance of products through accelerated merchandising techniques make up a spiral from which everyone bene-

fits. The leaders in automation will increase production rates and reduce manufacturing costs. In turn, the unit cost of the finished product will be reduced, permitting a lower sales price. This will widen the market for the product, and greater sales will result. As a part of reducing costs, the manufacturer will also want and need to purchase component parts from suppliers at a lower cost. This means that the suppliers competing for this market also will find it desirable and imperative to automate in order to reduce costs. They will, therefore, achieve similar benefits, and automation will be working for all.

Other stimulants to automation have been high taxes, high wages, shorter working hours, and other high operating costs.

To assist your clients to recognize by example the practicability and desirability of automation, there are a number of products and industries where automation or partial automation have already appeared. Bakeries are a good example. Operations consist of mixing basic materials and then controlling their processing from one step to the next until the product reaches an automatic inspection and weighing station. The final step is the automatic packaging for immediate shipment.

Automation has been applied in the petroleum industry. The crude, as raw material, is piped into the processing equipment and comes out as petroleum jelly, aviation gas, butane gas, protane gas, grease, lube oil, kerosene, and innumerable by-products. And all of this is accomplished without hand work. Heat, pressures, flows, levels, measurements, conveying, and packaging are all completely manipulated and controlled by automation. From well, pipeline, or tank-car to shipping platform, every operation is automatically controlled, and "labor" consists of engineering, supervision, and maintenance.

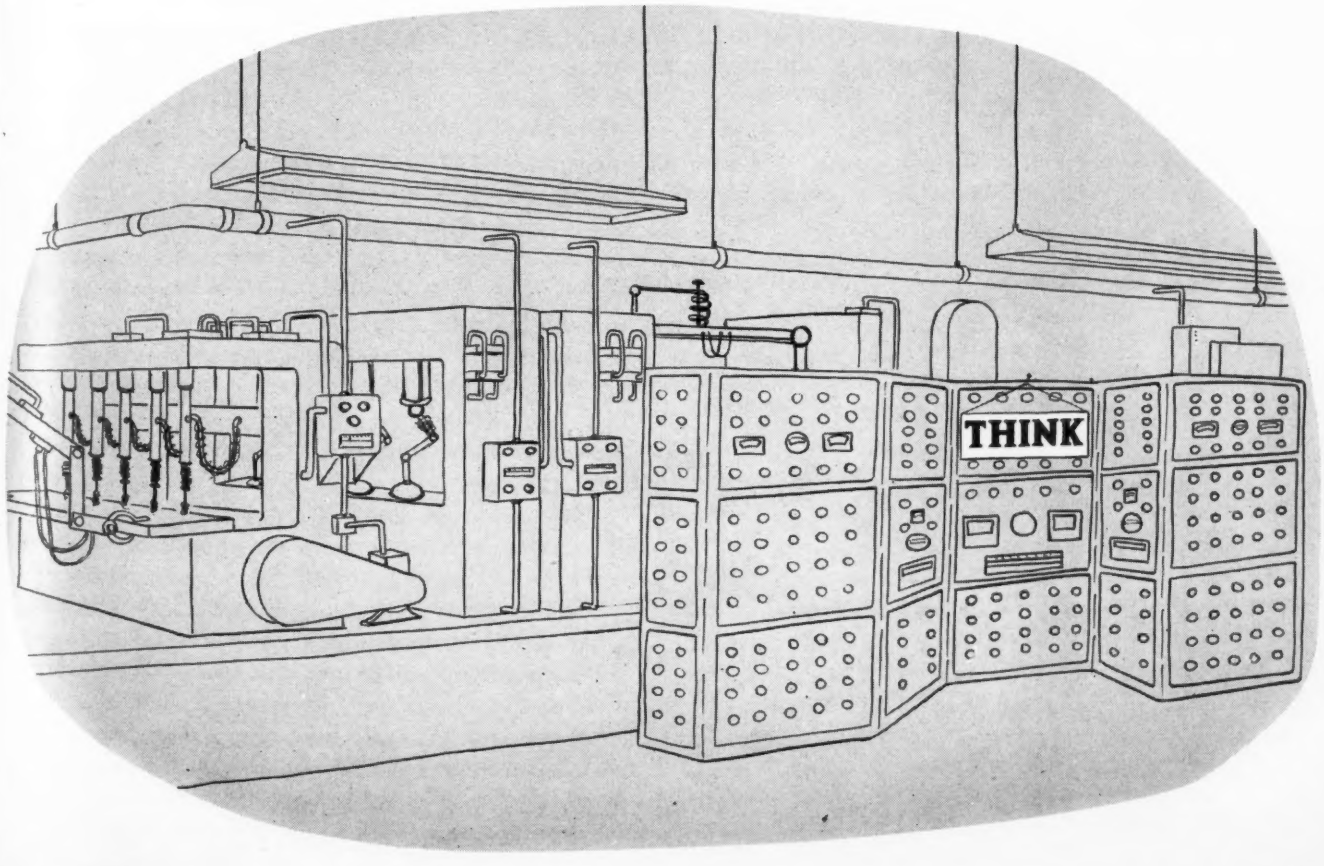
The trend toward automation is gaining momentum. No one industry has a monopoly on it. Consulting engineers must, therefore, assist their clients in keeping abreast of changes and advancements.

The most important advantage of automation is cost reduction. This is brought about by increasing the output per worker, and by amortizing the machinery over a relatively short period of time. Next, automation will increase quality. With the elimination of many of the errors now due to human failure, automation reduces spoilage and rejects and assures uniformity of quality.

Automation will free the worker of monotonous jobs, permitting him to use his higher skills. Furthermore, automation makes the worker's job safer and more comfortable in addition to making it more interesting and satisfying.

Partial Automation

For many companies partial automation has been and will be the practical approach. It is not necessary to replace an entire factory or production line, nor is it necessary to build an entirely new manufacturing installation to participate in automation and its benefits. We have found among our clients those



"It started the day someone took his Reader Service Supplement."

He will Be Happy Again In September

In September there will be another issue of CONSULTING ENGINEER'S ***Reader Service Supplement.*** Then our fallen friend will have his own copy, and he will know where to go to get the material and product information he needs for the specifications on that new project he's working on.

CONSULTING ENGINEER is the only magazine in any field giving readers this special service in a package they can use and file.

Bulletins, brochures, catalogs — technical literature of every advertiser is offered the readers in a Special Supplement, ready for reference and up-to-date.

The February Supplement drew 9,479 requests from readers for advertiser's literature.*

The June Supplement is running ahead of February.

September will beat them both.

**February total circulation—9,734 copies*

Sell the men who write the specifications

consulting engineer

who are progressive and want to apply the techniques of automation to their plants, but for excellent reasons it is not practical for them to consider complete automation. Through partial automation, some of the benefits can be achieved in a relatively short time, yet, on a basis that is consistent with the interests of the client.

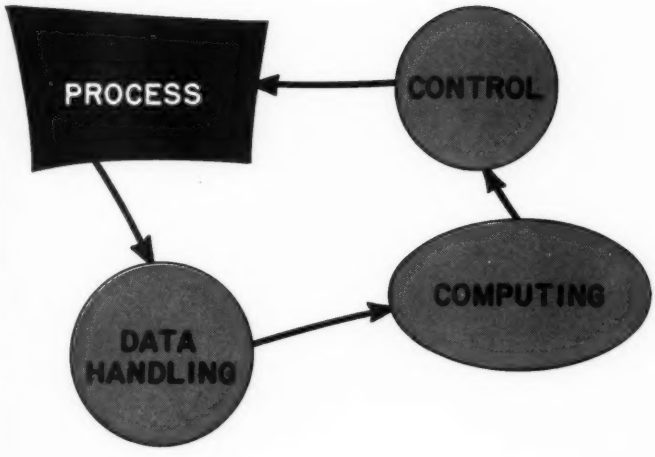
Usually, partial automation is applied on a step-by-step basis starting in specific phases of manufacturing where the costs are highest. Partial automation also should be considered when changes or improvements in trouble spots are made. If there is an overall automation program in view, additional component parts of the program can be engineered and installed at a later date with the ultimate objective of a complete production system. Approaching automation on a partial basis brings it within the reach of most company budgets. Concrete plans and programs should be laid out by these companies immediately.

This is where the consultant plays an important part in fulfilling his responsibility to his client. The consultant will want to help the client determine the type of program that is best and most practical so that any action taken will be not only economically sound for the present but will also permit the client to be ready for the increased productive effort needed for increased markets in the future.

Time to Plan Now

To be prepared for the expected increased markets and in order to meet competition, your clients must plan now. The first step is an automation study or survey. Since a great deal of specialized information and engineering knowledge from many fields is necessary, companies planning for automation should seek the assistance of specialists who can appraise automation possibilities from an objective and impartial point of view. Therefore, consulting engineers will play an increasingly important role in helping their clients study and analyze the many factors that must be considered before automation or partial automation can be placed on the calendar for action. This study necessarily includes capital, product, production, supervision, personnel, costs, accounting, and distribution. Once these have been analyzed, your clients will then know the answer to the important question as to whether or not they are ready for automation or partial automation. Furthermore, you can tell the clients which type of program will be most practical and feasible.

We, as consulting engineers, have a definite responsibility to industry in the era of automation. Because of the complexity and diversification of the knowledge required, the value of our combined objective viewpoint will be highly important. Since automation is definitely here and growing very fast, we cannot stand by idly without alerting our clients to its attractive potential and assisting them with their programs.



New Era in Instrumentation

Data Handling Systems

S. D. ROSS

CE exclusive

BY PAST DEFINITIONS, instrumentation — whether for power generation, waste disposal, chemical production, petroleum refining, or other industrial processing — meant, first of all, measuring common variables like fluid flow, temperature, or pressure, and providing a visual indication or a permanent chart record of the results. These indications or records were used by the operators as immediate guides for controlling the processes. Management employed the data, manually transferred to log sheets or reports, for cost accounting and long range guides to desirable changes in operating methods or to check efficiency.

Such measurements next were used primarily for automatic control, usually with a simple group of individual feedback loops for the different measured variables. Indication or recording remained an important part of these systems, with the operator observing trends on centralized panelboards and then using this information to guide his decisions to change controller set points, valve openings, and other control settings. Graphic panels with miniature recorders and indicators were widely adopted later to condense these visual data. The operator or superintendent, like a physician, could diagnose from "pulse," "temperature," and "blood pressure."

Data Handling Systems

In all of these systems these data were manipulated by the human mind. Now a host of newer systems are appearing known as data handling or data reduction systems. These are carrying the data gathering steps of instrumentation further by converting the visual indications or chart records into digital figures that can be logged directly on record sheets. Or the data may be converted directly into punched card or perforated tape form for direct feeding into computer equipment that automatically calculates statistical or operating information.

Data handling systems have many advantages, particularly for applications involving a large number of variables. They can perform such functions as: automatic measuring, automatic logging, and visual digital indication. Automatic scanning and monitoring as well as automatic control functions can be combined with the data handling functions to provide an over-all supervisory control system. Logging means the actual printing of records of the variables, while scanning means the rapid checking of values on a cyclic basis. Monitoring adds the function of automatically determining whether the variables are above or below preset limits.

Some of the advantages of the combined types of data handling systems are:

¶ Higher speed in obtaining results from test data.
¶ Elimination of errors inherent in hand logging.
¶ Releasing of manpower for more productive jobs.
¶ Permanent logs of operation.
¶ Ease of reading and interpretation.
¶ More efficient use of equipment.
¶ Protection of equipment.

Measurement Conversion

Since each of their primary functions — logging, indicating, and monitoring — starts with measurement, all data handling systems require analog-to-digital converters to provide data in digital form. Inherently, most measurements are made by analog devices, wherein an effect is produced analogous to the variable. To illustrate, a thermocouple measuring temperature generates a small voltage. This voltage may be transformed into the angular displacement of a pointer on a scale in a D'Arsonval millivoltmeter. An observer can convert this pointer position into a digital figure by reading the instrument; thus he acts as an analog-to-digital converter.

Converting mechanisms can be incorporated in conventional instruments to translate shaft position, for example, into electrical signals that can be used to actuate various types of readout devices as listed in Table 1. One or several of these readout devices also can be tied in directly with computers to process

information as rapidly as it is collected. Computers even may be tied-in directly in a control loop.

A Step Toward Automation

Data handling systems in processing plants are visualized as a vital link in the chain toward complete automation* of the operation. Instrumentation today can provide almost all the data required, but usually complete automation depends upon rapid correlation of the results from several monitoring systems to produce control without an operator's interpretation of the separate data. In practice, reducing the data to a form usable in an automatic computer permits a machine to make the routine decisions. Then conversion of the computer's output into control signals provides the means for replacing the operator's hand for adjustment of controller set points, manipulation of valves, or the regulation of other system components.

The title illustration is a simplified diagram that shows the broad functions involved in a completely integrated system of this type. The single arrows between blocks represent a host of different signals gathered from the process, fed to the computing and control equipment, and thence carried back to the process. Hundreds or even thousands of different data points may be involved, a number of which may be for logging purposes only with the remainder used for automatic control.

Benefits

Benefits visualized for integrated control systems in future plants include: more efficient use of manpower, with operators retrained for new roles of supervision and specialized maintenance; increased accuracy in records and control; and quicker gathering of pertinent accounting and operating data. Processes of increasing complexity but with higher rates of production will become feasible where today the human element is a limitation. More accurate control will mean higher product quality, less waste, and a general increase in plant efficiency, while the rapid interpretation of pertinent data will simplify cost accounting methods and facilitate the management of plant operations.

These complex systems entail high initial cost and maintenance. Only large, continuous operations with high volume or dollar value of product can currently justify the investment. Furthermore, the complexity of the equipment employed inherently implies the probability of increased maintenance expense although designers will attempt to minimize this factor.

Typical System Components

Data handling systems usually include a combination of engineered components that are designed to permit flexibility in application.

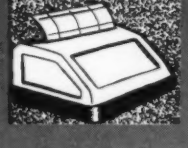
Transducers of several types are used to convert the many types of output signals from measuring elements into electrical input signals for the data

*Automation is used in its simplest and broadest sense—a synonym for automatic control. This meaning is entirely acceptable according to a recent survey.

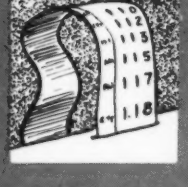
TABLE 1 — TYPICAL READOUT DEVICES

Digital Indicator. With this unit digital values of variables are visible through a small window. Information can include identification of the variable, the time, and other pertinent data as desired.

Automatic Electric Typewriter. Often column log sheets are advantageous. One or several automatic electric typewriters can be used to record digital values of a number of variables in tabular form under predetermined headings.



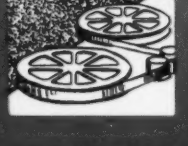
Adding Machine Tape Printer. Where the logging does not require the column log produced by typewriter, the adding machine tape printer can be used. This unit combines some of the computing capabilities of the adding machine with the recording of data covering a single variable in long vertical columns.



Card Punch. The conventional IBM punch card is well known. It provides data in punched card form for historical records or for further use in a computer.

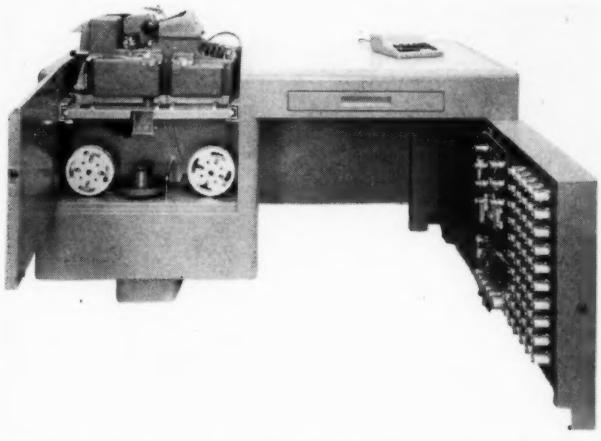
Paper Tape Punch. When very large numbers of variables must be recorded and then transported some distance, further processed, or fed into a computer, data can be punched on paper tape.

Magnetic Tape Recorder. Although it does not provide a visible record, the magnetic tape recorder is advantageous where high speed of recording of variables is required. Tapes also are useful for feeding information into computers.

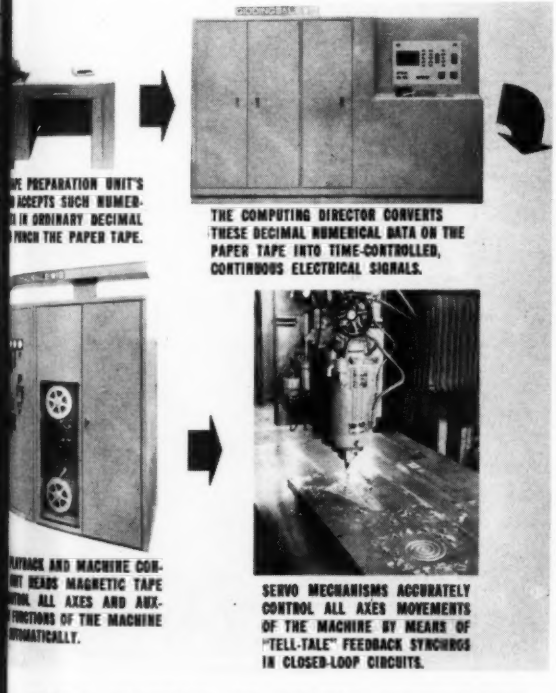


Data Handling at Work . . . The Giddings & Lewis Numericord System of Machine Tool Automation

OPERATOR AT 16-KEY ELECTRICAL CONTROL KEYBOARD.



OPEN VIEW OF THE PAPER TAPE PREPARATION UNIT.


E PREPARATION UNIT'S
ACCEPTS SUCH NUMER-
IN ORDINARY DECIMAL
PUNCH THE PAPER TAPE.
THE COMPUTING DIRECTOR CONVERTS THESE DECIMAL NUMERICAL DATA ON THE PAPER TAPE INTO TIME-CONTROLLED, CONTINUOUS ELECTRICAL SIGNALS.
AYBACK AND MACHINE CON-
UNIT READS MAGNETIC TAPE
NTROL ALL AXES AND AUX-
FUNCTIONS OF THE MACHINE
OMATICALLY.
SERVO MECHANISMS ACCURATELY CONTROL ALL AXES MOVEMENTS OF THE MACHINE BY MEANS OF "TELL-TALE" FEEDBACK SYNCHROS IN CLOSED-LOOP CIRCUITS.

BLOCK DIAGRAM OF SYSTEM COMPONENTS.

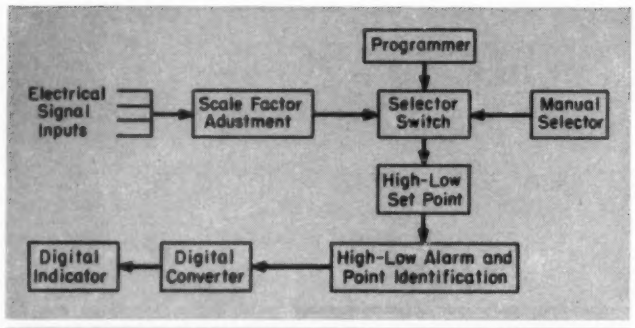
MAGNETIC TAPE PLAYBACK UNIT FOR MACHINE ATTENDANT.

handling system. For example, one set of transducers is employed to convert the standard 3 to 15 psi signal of pneumatic transmitters into an electric signal.

A scale factor adjustment unit is required in a digital data system because the magnitude and form of the transducer signals may vary greatly. A single logging system, for instance, may receive signals from thermocouples (millivolts), flow and pressure transmitters (3 to 15 psi air transduced to electrical signals), and analytical instruments (volts). This unit has adjustments whereby all of these signals can be adjusted to provide a common signal that truly represents the value of the variable when converted to digital values.

A selector switch funnels the many channels of information into one or two channels. This must be done at high speed with no chance of confusion. Two of the many types of switches for this service are the homing type stepping switch and the crossbar switch. The stepping switch is used where a predetermined order of operations or channels is needed, such as in periodic logging. The crossbar switch is used where any one of many points may be needed at one time.

A manual selector permits the operator to select



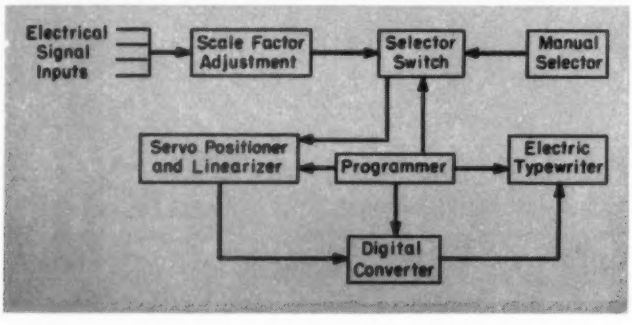


FIG. 1 — TOP. A TYPICAL MONITORING TYPE SYSTEM.

FIG. 2 — BOTTOM. A TYPICAL LOGGING TYPE SYSTEM.

any one of many points by hand. It has three general forms: an adding machine keyboard, a rotary switch, or a telephone type dial. The operator selects his desired point by pressing a coded key, turning a switch, or dialing a number corresponding to the desired point.

A programmer is the heart of any data handling system. It controls the operation of the entire system, establishes the routine of instruments, selects measuring circuits, switches points, initiates logging, provides information for printing time on the records, and performs many other similar functions.

A high-low set point unit is used by the operator to establish the maximum or minimum value of an individual variable or of group set points in a monitoring system.

A high-low alarm and point identification unit senses the fact that a given measured variable has gone above or below its limit. At the same time the unit identifies the variable and sounds an alarm. Actual operation of this unit can vary greatly depending upon the program required of the system. When connected to suitable relays, the unit also can act as a multipoint controller.

A servo positioner and linearizer may be used as the first step in the conversion of the variable signal from an analog to a digital form. The converted signal thus can be amplified and any nonlinearity that it possesses also can be removed.

A digital converter, as defined previously, must be used to convert the incoming signal to proper form for actuation of the readout device.

Computers are employed to perform such functions as integration, averaging, and summation of the data being handled.

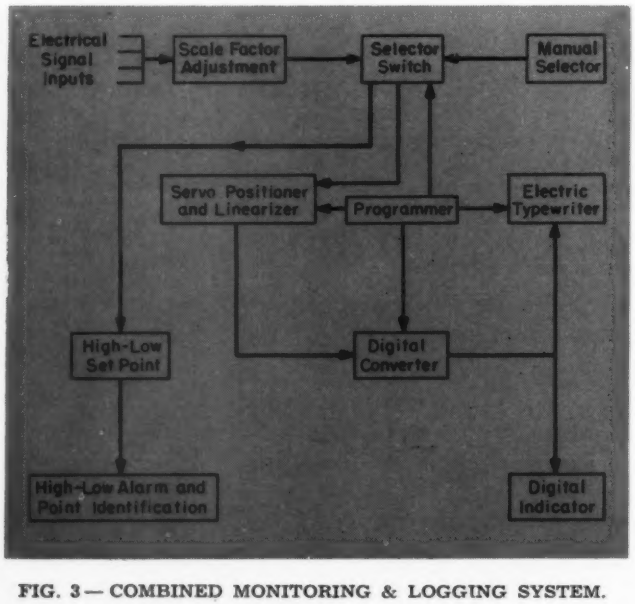


FIG. 3 — COMBINED MONITORING & LOGGING SYSTEM.

Typical Monitoring System

Fig. 1 shows a monitoring system with a relatively simple combination of components. This system provides monitoring of a group of variables on a predetermined program, with high-low alarm and point identification. In addition, an indicator permits manual or automatic indication of the variables in digital form. Most of the components are designed for relay rack mounting. Often some of them are incorporated in a compact console desk that also would contain the digital indicator.

Typical Logging System

At installations where it is necessary to print the value of a large number of variables at periodic intervals, the typical logging system (Fig. 2) is convenient. With this arrangement data are recorded in column log form on an electric typewriter, which might be incorporated at the top center of a console desk containing many of the system components. Other types of readout devices also could be substituted for or combined with the typewriter.

Monitoring and Logging System

This system (Fig. 3) combines the simpler monitoring and logging functions into one unit. Indication is provided by a digital indicator as in the monitoring system and a permanent log is made with an electric typewriter. A typical program for this type of system would be: a logging cycle on the hour; continuous scanning at one point per second between logging cycles; and indicating abnormal conditions.

Typical Measuring System

One typical application of a data handling system to measure flows, compensated flows, pressures, and

temperatures is illustrated in Fig. 4. Signals of the compensated flow channels are brought to pneumatic computing relays where they are pneumatically multiplied together, the output being 3 to 15 psi air signals. These signals then are fed into linear pressure-to-electric transducers. The output of these transducers is a voltage which is a linear function of flow rate. Uncompensated flow channel signals are brought directly to the linear pressure transducers without passing through computing relays.

If it is desired to compute integrated flow and/or average flow, an integrated flow-average flow computer can be used to integrate the flow and divide by time to produce average flow. This unit integrates flow continuously with time and averages flow for any period between three minutes and one hour. It is arranged so that no time is lost during readout and so that the total flows and average flows are computed over the same time period, respectively, for all channels.

Pressure channel signals similarly are brought to pressure-to-electric transducers, where the 3 to 15 psi signal is converted to an output voltage which is a linear function of pressure. Then the converted flow and pressure signals along with the temperature signals — already in the form of thermocouple voltages — are brought to the selector switch after a scale factor adjustment has been made. From this point, the electrical inputs are handled as shown in the illustration of the logging system.

Specifications

The following specifications are typical for this type of data handling system. They are presented in general terms, since they may vary considerably depending on the particular system design, even for a specific application.

¶ Printing speed is three seconds per point with the faster systems available.

¶ Data ordinarily are printed in three digit numbers, although additional digits can be provided when needed.

¶ A logging cycle normally is initiated automatically at hourly intervals, but provision can be made for setting the cycle time at specified intervals of more or less than an hour or for continuous printout. Provision is made to manually initiate a cycle or to reset a partially completed cycle. The time that a logging cycle is started is printed at the beginning of the cycle. Preprinted log sheets can be used to identify the logged channels and to give the units of the variable, or this can be a part of the printed information.

¶ There is no interaction between the data handling systems and the measuring and control instruments to cause an error in recording or upset of control.

¶ Provisions can be made for explosion-proofing where this is made necessary by the location of the system installation.

¶ Accuracy is commensurate with current commercial practice.

Typical Measurements

Many combinations of variables can be measured and recorded with this system. Representative examples are:

Pressure — psi, in. wg, or in. Hg.

Temperature — degrees Fahrenheit or Centigrade.

Average flow rate — liquids in barrels per day, steam in pounds per hour, gas in SCF per hour.

Integrated flow — liquid in barrels, steam in pounds, gas in SCF.

Tank level — feet, inches, or fractions of an inch.

Force — pounds.

Displacement — feet or inches. ▲▲

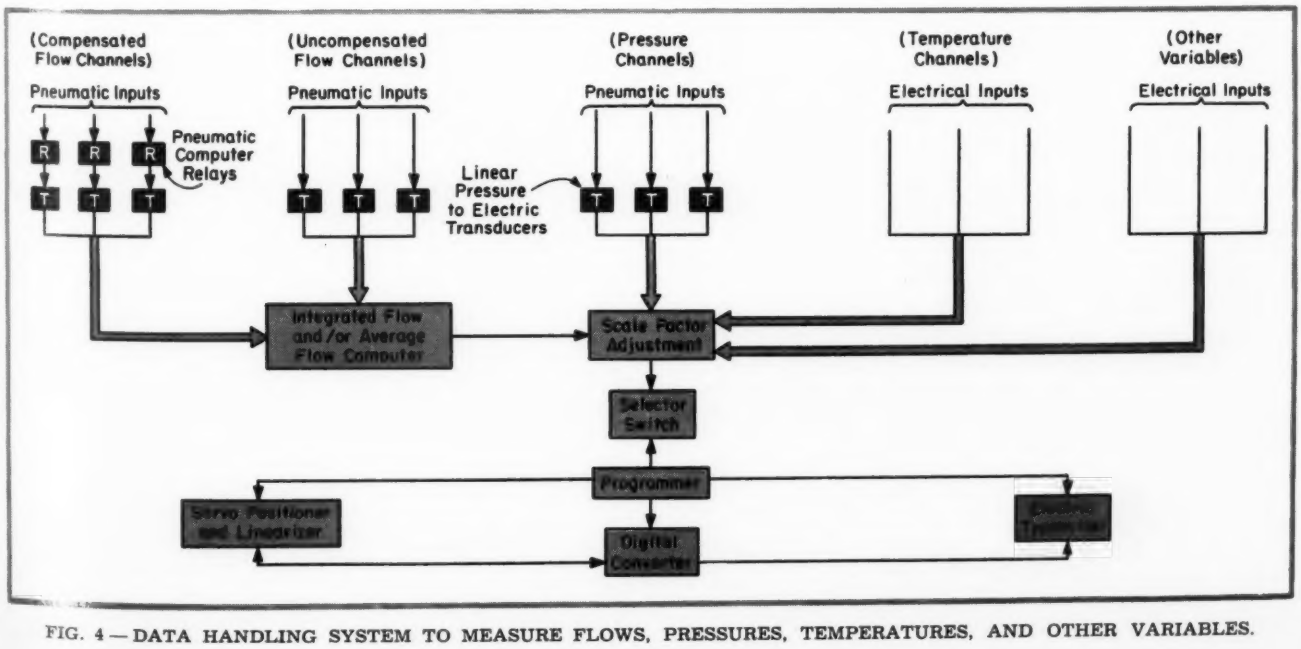
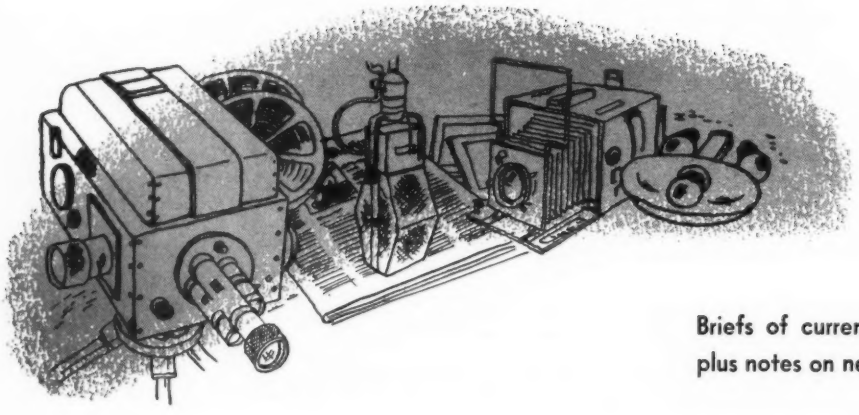


FIG. 4 — DATA HANDLING SYSTEM TO MEASURE FLOWS, PRESSURES, TEMPERATURES, AND OTHER VARIABLES.



NEWS

Briefs of current interest to the consulting profession plus notes on new equipment in the field of engineering

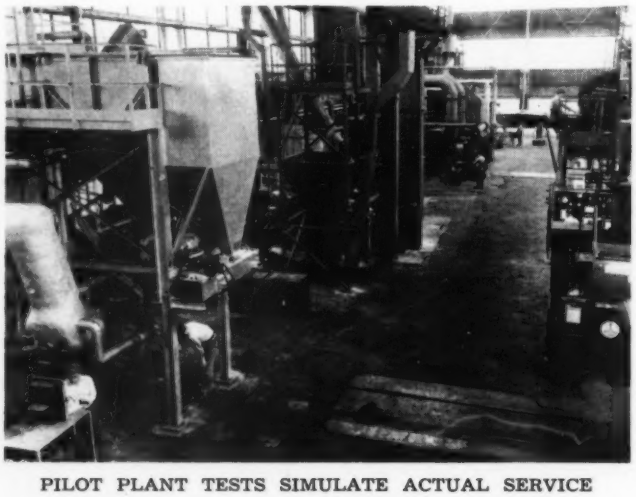
Research Center Engineers Seek Better Ways to Utilize Heat Energy

Recently Babcock and Wilcox officials conducted a group of technical editors through their Research Center at Alliance, Ohio. Started in 1947 with one building, this Research Center now has eight operating and three storage buildings staffed by 354 people of whom 121 are technical graduates including: mechanical, chemical, electrical, and mechanical engineers; chemists; physicists; and mineralogists. Its broad aim is to conduct investigations to find better ways to release, contain, transport, absorb, convert, and utilize heat energy regardless of source.

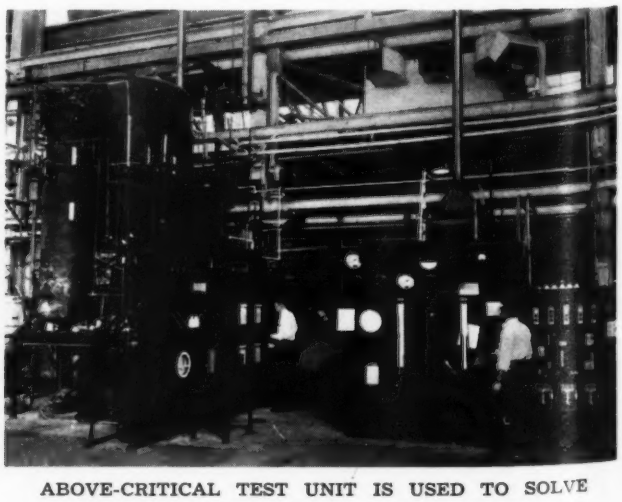
Basically, the Research Center uses three divisions in approaching the complex of problems: product development, materials development, and technical services. These divisions, whether acting alone or as sources of mutual information, keep ahead of the steadily increasing needs of advancing technology. Investigations are conducted on the factors limiting the efficiency of heat utilization of fuels, of engineering materials, and of the same materials incorporated into functional designs.

Facilities available at the center include: an alloy foundry; welding building; creep and stress rupture laboratory — believed to be the largest in the world; metallurgical laboratory; engineering physics section handling testing and design problems in the fields of electronics, stress analysis, fluid flow, and heat transfer; chemical laboratory with spectrographs, microscopes, X-ray diffraction instruments, and high temperature viscometers; and test stations from pilot to full scale for product development.

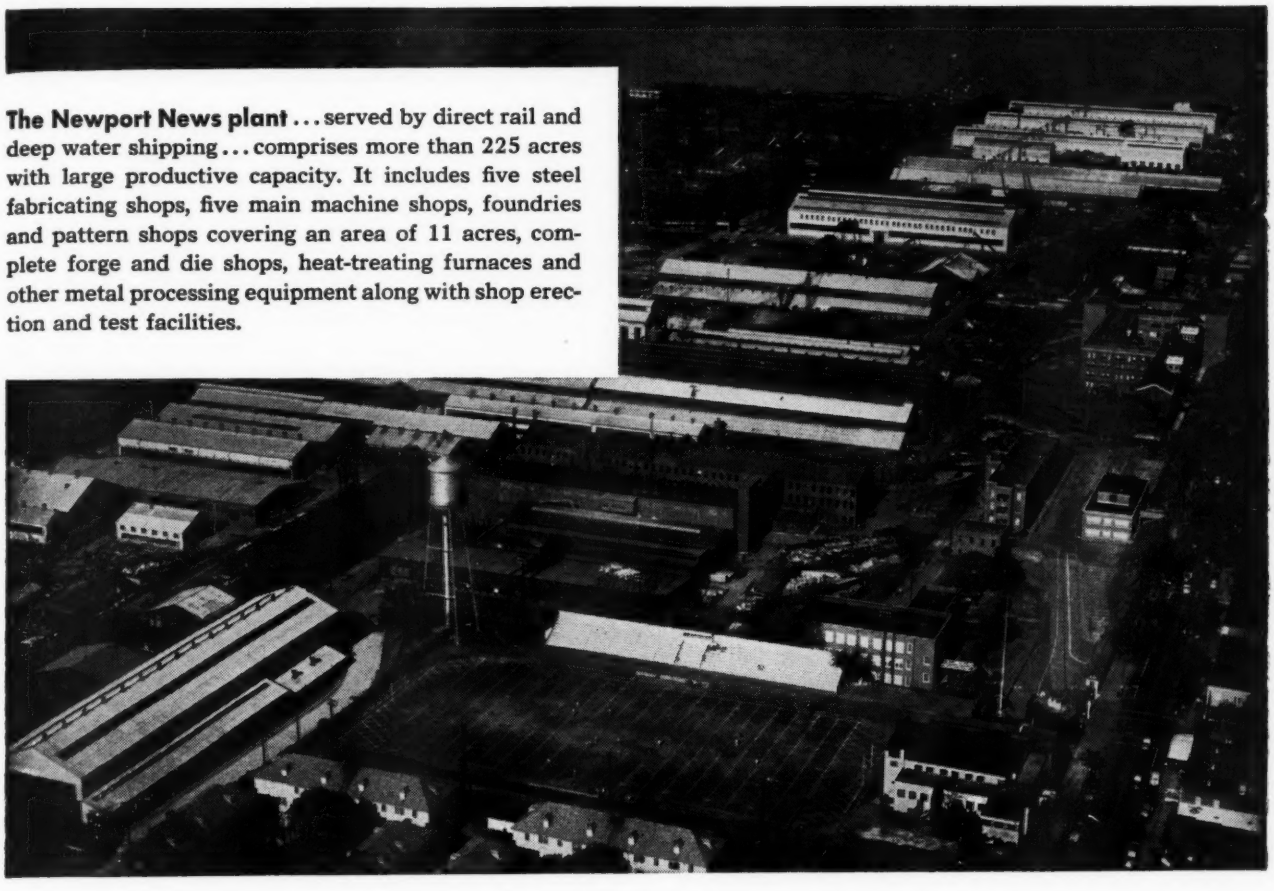
Since research is a continuous procedure, enumerating accomplishments at the Center would be impossible, but certain developments are of immediate interest. Studies of super-strength alloys to withstand temperatures as high as 1250 F in steam boilers have produced five very promising compositions possessing long-time rupture strength two to three times greater than that of the 18 Cr - 8Ni type alloys — now the strongest superheater materials available. New automatic submerged-arc process welding equipment has been developed that deposits metal five times faster than present automatic units. Extremely sensitive methods for analyzing both feed-water and steam, including the use of the radioactive tracer technique, are expected to solve the problem of silica deposits. Refractory concretes for temperatures up to 3200 F and Kaowool insulation — fibers made from clay — for temperatures up to



PILOT PLANT TESTS SIMULATE ACTUAL SERVICE CONDITIONS IN DEVELOPMENT OF EQUIPMENT.



ABOVE-CRITICAL TEST UNIT IS USED TO SOLVE PROBLEMS OF ONCE-THROUGH BOILER OPERATION.



The Newport News plant ... served by direct rail and deep water shipping ... comprises more than 225 acres with large productive capacity. It includes five steel fabricating shops, five main machine shops, foundries and pattern shops covering an area of 11 acres, complete forge and die shops, heat-treating furnaces and other metal processing equipment along with shop erection and test facilities.

Make Newport News your source for fabricated metal structures

Let Newport News fabricate your weldments or sub-assemblies. Call on us for plate fabrication...from vacuum tanks to bridge caissons ... for pumps, valves, pipe lines ... you'll find that Newport News fabricates parts to answer most demands.

In the vast plant, shown above, Newport News craftsmen complete your orders with specialized production techniques, and with sound experience acquired through construction of thousands of products ranging from small components on rayon spinning machines, to the giant 165,000 hp hydraulic turbines at Grand Coulee.

See for yourself what Newport News is doing, and how this company's high integration of skill and production facilities can help you. Get the facts, shown in *Facilities and Products.* A copy of this illustrated booklet is yours for the asking ... write for it now.

Newport News
Shipbuilding and Dry Dock Company
Newport News, Virginia

Research Center

—Starts on page 64

2000 F already are having a profound effect on furnace construction methods and costs.

For consultants, the technical services division presumably would hold the greatest interest. The personnel in this group are responsible for the background research and feasibility studies for many engineering projects. They design pilot plant equipment and special test apparatus and provide specialists in heat transfer, fluid flow, thermodynamics, mathematics, and process and equipment design as consultants for projects in the material and product development sections. They make fundamental knowledge available to other technical groups in the Company, and act as a clearing house for the exchange of basic engineering information.

For example, based on Research Center findings, several power stations already have begun adding dolomite to fuel oils. Reports show feeding as little as 0.001 lb of dolomite to 1 lb of fuel has eliminated sulfuric acid corrosion almost completely. Test data has been used successfully to evaluate other additives for alleviating ash fouling, and to measure the effects that different operating conditions have upon the design and arrangement of soot blowers. Recently, a large electric company came to Alliance with a problem — it wanted to acquire rights to a Midwestern coal mine but was afraid that the coal might not be suitable. Core samples were analyzed by special methods developed by B&W and found acceptable. On the basis of these tests, the electric company proceeded to lease the mine.

Consultants also would be interested in the continuing studies on both below and above critical pressure steam generation as well as the significant developments in the field of atomic energy. Ultimately such technological advances will influence the consulting engineer's own project designs.

Prefabricated Bridge Cuts Construction Cost and Time

Plans for a 280 ft bridge to span the Kenai River at Schooners Bend, Alaska called for pre-casting and pre-stressing sand and gravel concrete girders at the job site. This would have entailed building a costly casting bed and using inexperienced local workmen. Shipping costs eliminated the possibility of making sand and gravel beams and slabs in the States and shipping them to the site.

C.M.R. Constructors, Inc., of Seattle, Wash., under contract to the Federal Bureau of Public Roads for construction of the bridge, requested that the Bureau modify specifications to allow use of lightweight expanded shale concrete for beams and slabs so that the prefabricated units could be made in the States and shipped in.

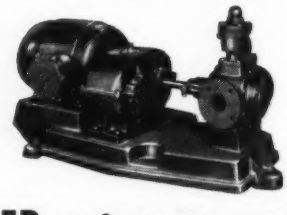
Empire Building Material Co. in Portland, developers of such a concrete (known as Lite-Rock), retained James and Honey, consulting engineers, to design the pre-stressed girders and make shop drawings for deck slabs and curbs. The girders were pre-stressed by the Freyssinet system with total pre-stressing force per beam at 600,000 lb. Strength of beams was obtained by tension rather than heavy reinforcement by steel. The finished bridge is completely pre-cast except for sub-structure and topping over the deck slabs.

The Lite-Rock concrete, which has a strength of 5600 psi, weighs ⅓ less than sand and gravel concrete making it economically possible to ship in what amounted to a prefabricated bridge.

LITE-ROCK PRE-STRESSED BRIDGE MEMBERS, ONE THIRD LIGHTER THAN CONVENTIONAL CONCRETE, MOVE EASILY.

"NEW PUMP" PERFORMANCE

after years of service



with BLACKMER rotary pumps

Here's how you can restore "new pump" efficiency at a fraction of the cost of a new pump, thanks to Blackmer engineering and design.

REPLACEABLE LINER It takes only a matter of minutes to replace the liner of a Blackmer Pump after excessive wear has been caused by the handling of corrosive or abrasive materials.

REPLACEABLE VANES The vanes in Blackmer Rotary Pumps are self-adjusting for wear and give sustained efficiency over years of service. In case of extreme wear or damage, they can be replaced quickly, using only simple hand tools.

Blackmer Rotary Pumps are handling hundreds of liquids and semi-solids successfully.

liquid materials handling ®

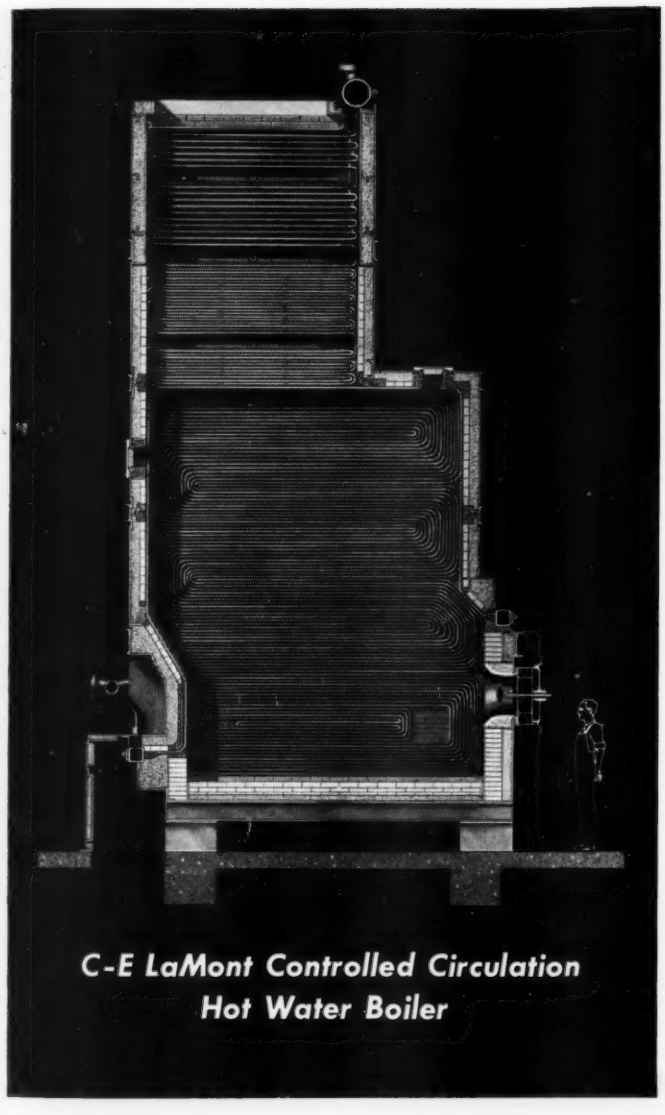
BLACKMER

Industrial, Hand and Truck Pumps, Strainers, Pressure Control Valves

BLACKMER PUMP COMPANY, GRAND RAPIDS 9, MICH.

DIVISION SALES OFFICES — NEW YORK • ATLANTA • CHICAGO
GRAND RAPIDS • DALLAS • WASHINGTON • SAN FRANCISCO

See Yellow pages for your local sales representative



C-E LaMont Controlled Circulation Hot Water Boiler

EVER CONSIDER HIGH TEMPERATURE WATER FOR YOUR HEATING AND PROCESSING NEEDS?

Both steam and high temperature water have their place, and your particular requirements will determine which is best for you. In either case the complete C-E line includes a type and size of boiler exactly suited to your requirements. Where high temperature (HT) water seems indicated, it affords such important advantages as:

The higher available heat in HT water... many times that of steam at the same pressure.

Closer control of temperatures throughout the system.

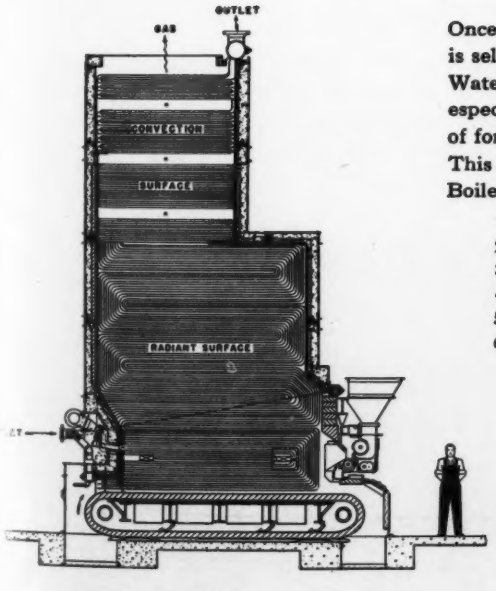
Heat loss is minor with the HT water closed system... no condensate losses... unused heat returns to the boiler.

No elaborate feedwater treatment required because make-up requirements are small.

No steam traps are needed, which means elimination of all trap problems and attendant expense.

No blowdown losses... no safety valve vent losses... no condensate return lines.

The planning of any new heating and/or processing system should give proper consideration to the suitability of the HT water system. There are many hundreds of HT water installations operating abroad and a rapidly growing number in the U.S.A. It may be *just right* for *your* requirements.



Advantages of the C-E Hot Water Boiler

Once it is established that HT water is right for your needs, your next concern is selection of proper equipment. The C-E LaMont Controlled Circulation Hot Water Boiler has inherent advantages that make it the best possible choice. It is especially designed for HT water applications utilizing as it does the principle of forced, controlled circulation which is extended throughout the entire system. This accounts for numerous points of superiority in the C-E LaMont Hot Water Boiler. Among these are:

1. **Complete control over HT water movement in both system and boiler.**
2. **Low pressure loss is inherent so no separate boiler pump is required.**
3. **Pressurized operation with oil or gas means no induced draft fan—simple stack.**
4. **Single-pass design—no baffles... low draft loss... cleaner boiler.**
5. **More efficient heating surface can be arranged because of positive, controlled circulation.**
6. **Other features such as: steel enclosed setting—few headers, all accessible—any fuel, oil, gas or coal.**

The C-E Hot Water Boiler is available in sizes ranging from 15 to 200-million Btu per hour, or more, with pressures up to 300 psi and temperatures to about 425 F.

If you are in the market for a heating or process system—or expect to be—by all means investigate high temperature water and the C-E LaMont Hot Water Boiler. Our engineers will be pleased to discuss the subject with you or your consultants. Write for our new catalog HT-257.

COMBUSTION ENGINEERING

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y. B-831-A

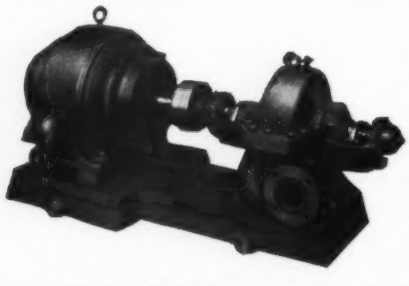
BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS & FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE

water

...the lifeblood of industry!

Utilize *your* water supply efficiently . . . economically . . . by equipping your distribution system with reliable, service designed WEINMAN Centrifugal Pumps.

A Weinman Centrifugal Expert is a "Doctor of Pumps" . . . whose professional skill can keep your pumping system free from "circulatory ailments" by diagnosing and curing your pumping problems before they occur . . . insuring troublefree operation at required pressures, and a constant supply at delivery points for industrial use or consumption.



WEINMAN 2-stage horizontal split-case centrifugal pumps assure adequate heads and capacities for every industrial need.

WEINMAN Pumps are backed by many years of pump-building experience . . . every WEINMAN installation is a custom installation, to handle your specific liquid-handling problems. A wide range of models are available for low and high head use . . . standard or non-clog . . . in required GPM capacities to suit your industrial needs. Talk over your pump requirements with an expert . . . a WEINMAN Centrifugal Specialist. Just write, wire or phone today.

Representatives in principal cities

Built by Centrifugal Specialists

The WEINMAN Pump Mfg. Co.

Prefabricated Bridge

—Starts on page 66

Consulting Work Abroad Takes Special Attributes

What are the requirements necessary for a consulting engineer to work abroad successfully? W. Rogers Herod, president of International General Electric Co., in a speech presented before ASME's Annual Meeting, listed four basic requirements:

¶ Comprehensive understanding of and devotion to the accomplishment of the objective.

¶ Technical competence, preferably accompanied by previous experience in foreign work.

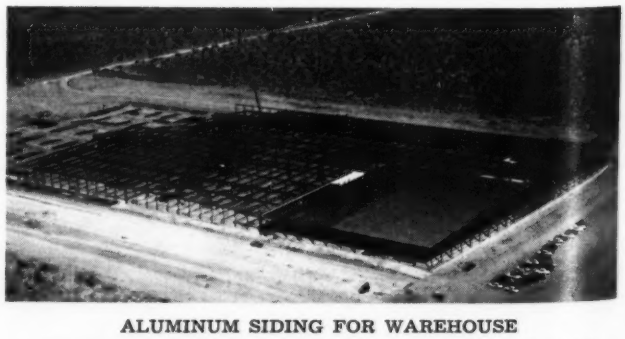
¶ High professional integrity.

¶ Adaptability to new situations.

Also desirable, according to Herod, are imagination, sense of responsibility, appreciation of the need for over-all economy, ability to adapt various engineering practices in relation to different economies and social backgrounds of other nations, and ability to achieve cordial working relations and mutual respect with the client.

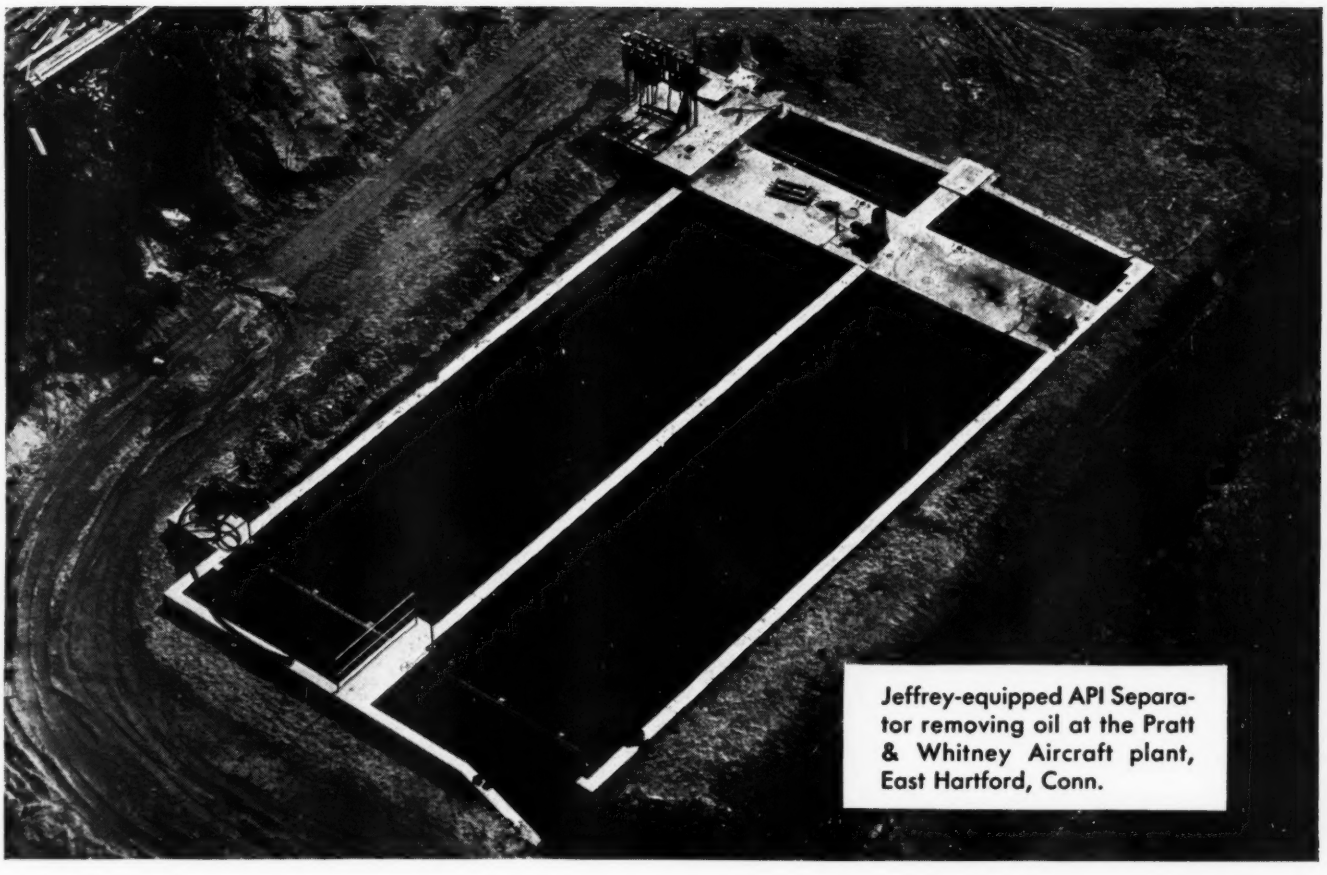
He went on to say, "With American economic assistance abroad and with American investments and foreign trade in such diversified forms, and with accelerated foreign activity, a field of considerable opportunity has been opened for American equipment and for American consulting engineers. Where dollar finance is important and where American equipment and techniques are preferred, the American consulting engineer is both needed and desired. However, where other than American finance, equipment, and techniques are involved, his field is more limited, and he has difficult competition. When engaged abroad his advice is frequently sought in non-technical matters.

"In whatever sphere they have operated our consulting engineers have effected a minimization of over-all cost and investment, and the maximum saving in time and resources." ▲▲



ALUMINUM SIDING FOR WAREHOUSE

Constructed of Alcoa's corrugated aluminum industrial siding with ½ in. Fiberglas insulation, this one-story warehouse constructed for North American Aviation is completely moisture proof. Six dehumidifying units remove up to 7½ tons of water per day and cargo doors are sealed with sponge rubber and neoprene gaskets for positive vapor seal. Architects were Daniel, Mann, Johnson & Mendenhall; contractors, Vinnell Corp.



Jeffrey-equipped API Separator removing oil at the Pratt & Whitney Aircraft plant, East Hartford, Conn.

JEFFREY has the answer to pollution problems

Are state or federal anti-pollution laws giving you headaches? Then call on Jeffrey Sanitary Engineers for practical relief. A Jeffrey-designed installation will neutralize your industrial wastes efficiently. Here's how:

CHEMICAL DOSING: Jeffrey WAYTROLS, Bin Check Valves and Vibrating Feeders assure continuous, automatic dosage.

MIXING: Jeffrey Flash Mixers, with turbine type impellers, mix chemicals thoroughly with wastes.

FLOCCULATION: Jeffrey FLOCTROLS coagulate particles and promote rapid settling.

SETTLING: Jeffrey automatic, continuous Sludge Collectors scrape deposit to sump at end where it is pumped out and de-watered or sent to lagoons.

Hundreds of industrial wastes treatment plants throughout the nation are now Jeffrey-equipped. Scores of industries have found Jeffrey's wide engineering experience and broad line of proved equipment the best answer to pollution problems.

Write for descriptive literature.

THESE JEFFREY UNITS WILL HANDLE YOUR INDUSTRIAL WASTES:

- FLOCTROLS
- Bucket Elevators
- Bag Elevators
- Sludge Collectors
- Sludge Elevators
- Lime Pulverizers
- Grit Collectors & Washers
- V-Bucket Collectors
- Specific Gravity Separators
- Transmission Machinery
- Scum Removers
- Oil Separators
- Oil Skimmers
- Chemical Feeders
- Chains & Sprockets
- De-Watering Screens & Dryers
- Belt & Spiral Conveyors

THE JEFFREY MANUFACTURING CO.

ESTABLISHED 1877

Columbus 16, Ohio

sales offices and distributors in principal cities

PLANTS IN CANADA, ENGLAND, SOUTH AFRICA

IF IT'S MINED, PROCESSED OR MOVED

. . .IT'S A JOB FOR JEFFREY!

MEN IN ENGINEERING

Ralph M. Watson, formerly director of research for Worthington Corp., has accepted an appointment as associate dean of the L. C. Smith College of Engineering, and chairman of the department of mechanical engineering, Syracuse Univ.

At the 26th annual installation meeting of the Kings County Chapter, New York State Society of Professional Engineers, H. Carl Bauman was installed as president. He is presently with Chemical Construction Corp. Other officers are Harold Becher, consulting engineer, 1st vice president; William Spivak, president of the Association of Civil Engineers in the New York City Service, 2nd vice president; Paul Klepper, engineer in the president of the Borough of Brooklyn's office, treasurer; and Irving J. Lake, senior engineer in charge of highway and sewer maintenance, secretary and historian.

Officers of the recently organized Expansion Joint Manufacturers Association are: president, John G. Dobson, American District Steam Div., ADSCO Industries, Inc.; vice president, Ralph Menke, Foster Wheeler Corp.; secretary-treasurer, George P. Byrne, Jr., Industry Service Bureaus; member of executive committee, James Zallea, Zallea Brothers.

Roy F. Vanek becomes an Associate at Stanley Engineering Co., consulting engineers, Muscatine, Iowa.

VANEK SPRONCK

Michael A. Spronck, formerly executive field editor of *Construction Equipment,* joins the staff of D. B. Steinman, consulting engineer as administrative assistant to Steinman.

McDonald Bros., engineering and construction firm of Los Angeles, announces formation of a Construction for Manufacturing Div. with Herman H. Rappaport as division manager. The new division will specialize in integrating its activities with those of client management to minimize interruption of production flow during building operation.

James A. Bjerregaard has joined Gibbs & Hill, Inc. as consulting civil engineer. He will be located at the Eighth Avenue office in New York.

Piette, Audy and Lepinay, consulting engineers, and Quebec Testing Laboratory have moved to 1134 St. Louis Road, Sillery, Quebec, Canada.

The board of supervisors of Jackson County, Miss. have retained the firm of Michael Baker, Jr., Inc. to plan industrial harbor facilities at Bayou Casotte, adjacent to the City of Pascagoula, Miss. Preliminary plans call for a 30 ft channel into Bayou Casotte from an existing channel about three miles out in the Gulf of Mexico.

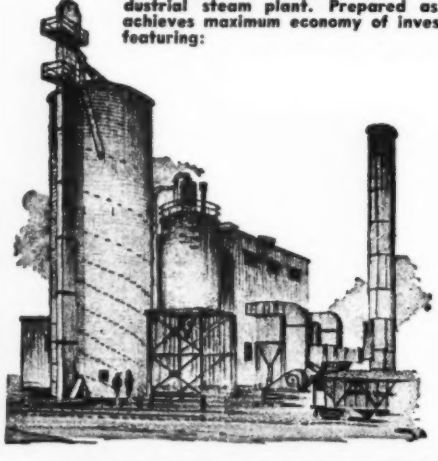
Ted Ray is appointed director of technical surveys at Designers for Industry, Inc. He will be in charge of gathering facts on market potential, design concepts, design and specification analyses, and similar types of data.

New officers of the National Council of Engineering Society Secretaries are: president, J. Earl Harrington, Western Society of Engineers, Chicago; vice president, T. J. Ess, Association of Iron and Steel Engineers, Cincinnati; treasurer, W. P. Youngclaus, American Society of

Modern Design *for the*

MODERN COAL

The Fairmont Coal Bureau has made available to consulting engineers and equipment manufacturers a TYPICAL DESIGN for the small industrial steam plant. Prepared as a guide to good engineering it achieves maximum economy of investment and engineering costs, while featuring:



- Fuel flexibility
- High efficiency
- Low fuel costs
- Minimum labor requirements
- Cleanliness, Automaticity, Reliability

Fairmont Pittsburgh Seam Coal is the MODERN COAL. Enormous reserves and inherently favorable mining conditions guarantee ample supply and low production cost. Modern mining and preparation facilities assure uniform quality.

Fairmont Coal Bureau engineers are freely available to help you solve fuel and combustion problems. Write for Technical Reference Bulletins and other valuable publications.

FAIRMONT COAL BUREAU

Dept. CE, 122 East 42nd St., New York 17, N. Y.

PUMPING PROBLEMS?

BRING THEM TO BJ

BJ SUBMERSIBLES

Byron Jackson manufactures all three basics of a submersible . . . the PUMP . . . the SEAL . . . and the MOTOR . . . and combines them in BJ Submersibles and Subettes. Complete range of sizes and types. Capacities range from 30 to 20,000 gpm, and heads up to 1800 ft. BJ Submersibles can be applied to all deepwell problems.

BYRON JACKSON IS READY TO WORK WITH YOU ON YOUR PUMPING PROBLEMS . . .

1. **BJ supplies a *complete* line of centrifugal pumps and mechanical seals.**
2. **BJ can job-engineer any special pump to the required capacity, head, pressure and power.**
3. **BJ has competent sales engineers in 36 cities throughout the country.**
4. **BJ backs you by parts and service facilities of a long-established nation-wide organization (since 1872).**

BJ SUBMERSIBLE BOOSTER PUMPS

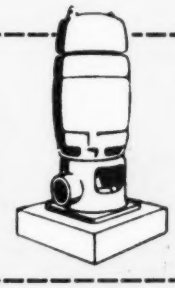
Complete pumping stations can be placed underground, under streets, parks, etc. Eliminate real estate investment and economically boost pressure for sub-division expansion, etc.

Write for BJ Bulletin No. 55-2-700

BJ DEEPWELL TURBINE PUMPS

Bowl and impeller assemblies to meet every deepwell need. Standard models for wells 6", 8", to 24" dia., capacities to 9000 gpm, heads to 600 ft. "Bee Jay" models for 4", 5" and 6" dia. Choice of water or oil-lubrication.

Send for BJ Bulletin No. 54-1-10,000



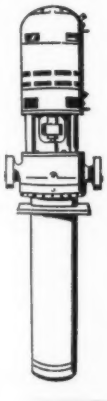
BJ LAKE AND RIVER INTAKE PUMPS

These pumps eliminate high or low water and icing problems on lake and river intake installations. Capacities to 20,000 gpm. Water-jacketed to operate in or out of water.

BJ BILTON PUMPS

General purpose pump with close-coupled motor pump unit. Mounts in any position. No rigid foundation needed. Ideal for portable service. Capacities to 2000 gpm, heads to 600 ft. Wide range of sizes.

Write for BJ Bulletin No. 353-1000



BJ HYDROPRESS PUMPS

Double-case pumps suitable for hydraulic press, boiler feed and descaling operations, other high-pressure, low-capacity water pumping requirements. Capacities to 500 gpm. Heads to 7000 ft.

Write for BJ Bulletin No. 52-6400

BJ VERTICAL PROPELLER PUMPS

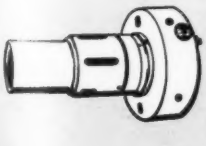
Single-stage pumps. For medium to high capacity jobs with low heads. Capacities to 50,000 gpm. Heads to 40 ft. For drainage, river-intake, dewatering, irrigation, etc. Easily adapted to special needs.

Write for BJ Bulletin No. 53-5800

BJ VERTICAL CIRCULATING PUMPS

Single or multi-stage. For pumping medium to high capacities of water. Two size ranges. Capacities to 50,000 gpm. Heads to 40 feet. Saves space, simplifies piping. For cooling tower, dewatering, drainage, river-intake and circulating.

Send for BJ Bulletin No. 52-6050



BJ MECHANICAL SEALS

High precision seals which replace standard packing in stuffingboxes. Types to fit all centrifugal pumps. Available for handling different pressures, temperatures and liquids.

Send for BJ Bulletin No. 54-1-10,000

BJ

SINCE 1872

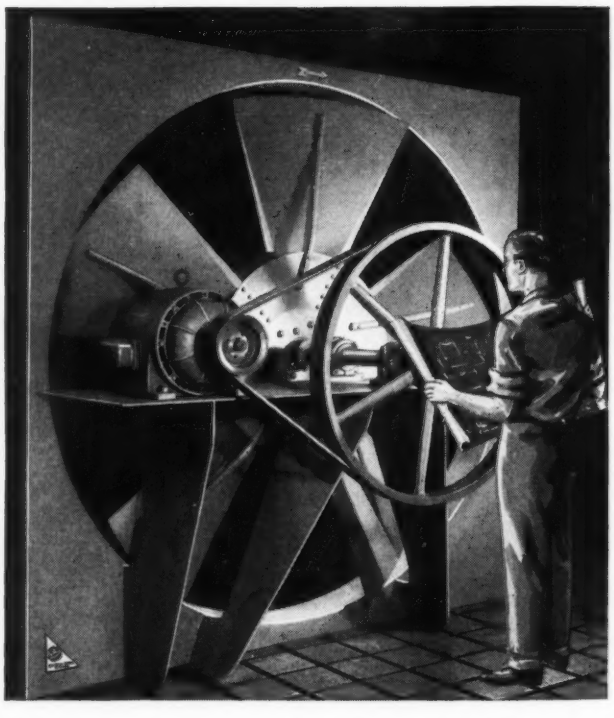
Byron Jackson Co.

PUMP DIVISION

P.O. BOX 2017, TERMINAL ANNEX
LOS ANGELES 54, CALIFORNIA

WHAT! A PROPELLER FAN THAT DELIVERS 250,000 cfm!

Yes — they're doing BIG ventilating jobs at propeller fan costs with this wide line of "Buffalo" fans!



- 8" to 120" sizes!
- Easy low-cost installation!
- Shipped completely assembled as a "Package".
- All high in efficiency! —for example, the 96" Design 53 Belt-Air delivers 115,000 cfm at 1/4" s.p. with a 15 h.p. motor!

From the smaller NV-Breezo Fans (8" to 24" sizes) to the Heavy-Duty NV (24" to 144" sizes) and Belt-Air Fans (24" to 120" sizes), there's a fan or combination of fans to ventilate everything from a small room to an entire plant—easily and economically. What's more, this broad "Buffalo" line offers you models for high temperature exhausting, for handling corrosive fumes and for static pressures all the way up to 1". Installation, of course, is simple and fast—just mount these husky, square-paneled packages in square wall openings. And with every "Buffalo" Fan, you get a bonus in quiet, efficient performance for extra years. It's the "Q" Factor*, developed over our 78 years of fan manufacturing. Write for catalogs today and pick the fan you'll always be glad you ordered.

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

BUFFALO FORGE COMPANY

147 MORTIMER ST. BUFFALO, N. Y.

Publishers of "FAN ENGINEERING" Handbook

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING
FORCED DRAFT COOLING HEATING PRESSURE BLOWING

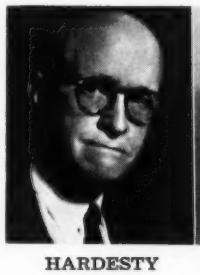
MEN

—Starts on page 70

Lubrication Engineers, Chicago; secretary, Charles S. Doerr, The Engineers' Club of Philadelphia.

Dr. D. B. Steinmen has been awarded the International Grand Prize of Invention for his inventive and scientific contributions and achievements in the design and construction of great bridges. The Permanent Committee of the Grand Prix International de l'Invention, which awarded the medal, was founded at Paris in 1954 by representatives of national and international organizations of scientists and inventors. Steinman is the first recipient of the award.

Shortridge Hardesty, partner in the firm of Hardesty & Hanover, has been designated Metropolitan Area Civil Engineer of the Year for 1954 by the Metropolitan Section of the American Society of Civil Engineers. The citation was for his direction of the design of the New York Central Railroad vertical lift bridge over the Harlem River. Last October Hardesty was elected an honorary member of the Society, its highest national distinction.

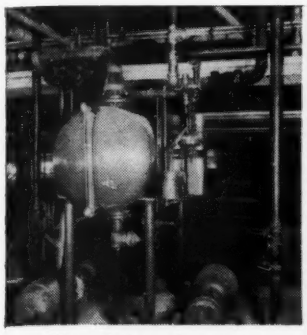


HARDESTY

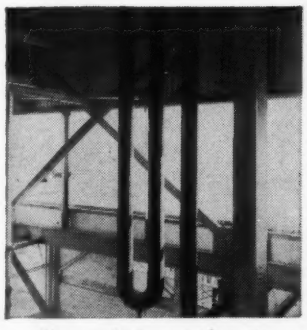
WEINGARTNER

Harold C. Weingartner, formerly president of National Research Corp., has joined the staff of Welling & Woodard, industrial consultants.

Stevens Institute of Technology has awarded Honorary Doctor of Engineering degrees to John L. Atwood, president of North American Aviation, Inc.; Robert W. Van Houten, president of Newark College of Engineering; and Isaac Harter, inventor and designer of steam generating equipment. Two former Stevens' students received Honorary Mechanical Engineering degrees: Robert E. Lange, president of Lange and Lange, Inc.; and Henry G. Schaefer, vice president of Baker, Smith and Co. Leslie H. Backer, head of Stevens' Dept. of Chemistry was awarded the Honorary degree of Doctor of Science. ▲▲

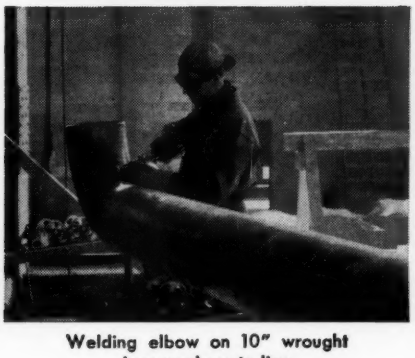


Wrought iron pipe serves condensate pump battery

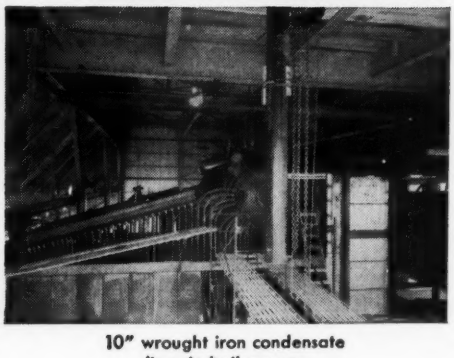


8" wrought iron condensate overflow line in boiler room

Wrought iron steam return on trestle between buildings



Welding elbow on 10" wrought iron condensate line



10" wrought iron condensate lines in boiler room

In its new Appliance Park, GENERAL ELECTRIC assigns WROUGHT IRON PIPE to corrosion "HOT SPOTS"

Quality—a key word in the planning, designing, and manufacturing of General Electric appliances—is also a basic Company consideration in the application of wrought iron in their new Appliance Park, near Louisville, Kentucky. More than 359 tons of this time-tested material was used to safeguard against corrosion in exposed water lines and steam return lines in all of the five buildings in the plant plan.

Architects and Engineers—Fairbrother-Miehls, Detroit, Michigan; Albert Kahn, Associated Architects and Engineers, Inc., Detroit, Michigan.
Consultants—Eggley-Furlow, Philadelphia, Pennsylvania.
General Contractors—Turner-Strock Construction Company.
Plumbing—Standard Engineering, George Blanford, Louisville, Kentucky.
Heating & Piping—Kerby Saunders, New York, New York; Meyer Ward, Louisville, Kentucky.

Our bulletin, *Piping for Permanence*, discusses these, and many other proved wrought iron pipe services. Write for your copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. International Division: New York, N.Y. *Available throughout the world.*

BYERS

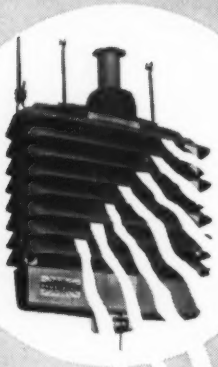
CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY STEEL PRODUCTS

Bring the Sun Indoors!



Your Plant can now have
EFFICIENT, HEALTHFUL HEAT
silent and draft-free
with
PANELBLOC
INFRA-RED UNIT HEATERS

- Comfortably heats workers and machines within radiation area.
- Heat not wasted on air which would normally rise to ceiling.
- No fan, motor or electrical connection needed.
- Never shut down due to power failure.
- Heat delivery cannot be diverted by drafts from open doors.
- No moving parts . . . less maintenance.
- May be used with any commercial type gas fuel.

Remember how comfortable it feels to stand in the warm sun on a cold day? That's how Panelblocs work. Gentle, comfortable heat rays warm everything they touch. You have all the advantages of conventional heaters . . . none of the disadvantages.

Panelbloc uses no fan. This means no drafts (heating is accomplished by guided radiation). With no electrical connections, Panelbloc costs less to install—will continue to operate during a power failure . . . and it heats, not air, but personnel and equipment . . . anything solid.

Panelbloc may be installed in practically any type structure for general heating; for spot heating in an otherwise unheated building; for heating a single room . . . In fact, almost any heating requirement can be solved with Panelbloc. Available in two models: 62,500 btu and 125,000 btu input.

For warm air heating check the Prat-Daniel THERMOBLOC Heater . . . used the world over.

THERMOBLOC
Division of
PRAT-DANIEL
CORPORATION
700 Meadow St. • South Norwalk, Conn.
Send Me Panelbloc Bulletin P-154
Name_____Title_____
Company_____
Address_____

FOR IMMEDIATE DELIVERY

. . . field and office

Mechanical reproduction of printed material, blueprints, and drawings has made surprising progress in the past few years. All sorts of new machinery and processes are coming onto the market every month—some good, some just so so. Many offices, however, limp along with antiquated equipment when newer, improved models would pay for themselves in a short time.

Photocopy machines, for instance, are now available in compact, desktop models that incorporate the developer right in the machine and produce dry copies in seconds. An example of this type machine is the Apeco Dial-A-Matic Auto-Stat, developed by American Photocopy Equipment Co. This model has an illuminated dial which can be set to match the type of original to be copied. A sharp, dry copy of anything written, printed, drawn, or photographed is produced in 30 sec. Filling and emptying the developer tank is done with a plastic squeeze bottle and tube. The same company also has a new photocopy paper that is five times more resistant to pre-fogging under incandescent or fluorescent lighting.

Whiteprinters

Improvements are also being made on whiteprinting equipment. Lower-priced, faster machines now on the market are simpler to operate and reproduce larger prints. Charles Bruning Co. has introduced such a unit, known as the Copyflex Model 500, for heavy-volume use in engineering, drafting, and architectural offices. It has 30 percent greater speed range (14 in. to 40 ft per min), improved print stacking features, and a synchronized electronic drive with selenium rectifiers in place of vacuum tubes. It takes prints up to 46 in. wide, any length.

Another new whiteprinter — on a much smaller scale — is the Rotolite, a unit that utilizes a dry developer to make white copies of translucent printing, drawings, and photos. To operate, a negative sheet is placed against the original and the two sheets inserted into the machine. The papers are drawn through and exposed automatically. The negative is then placed in a dry developer and is ready for use in one minute. The unit can be plugged into any 110/120 v wall socket. The Rotolite Co. is producing these machines in three sizes for copies from 18 to 42 in. wide, any length.

Xerographic Equipment

Offices with the problem of reproducing engineering drawings in quantity will be interested in new Xerographic copying equipment which will reduce drawings up to 24 x 36 in. onto a 12 x 18 in. paper master for runoff of multiple copies on an offset duplicator. Known as the XeroX 1218, the equipment consists of a copying camera, charge units, developing tray, cleaning tray, transfer unit, and a fuser for making the paper master image permanent. It is available from The Haloid Co.

Your librarian will be glad to hear that there is now available an efficient photocopy unit for reproducing pages from any type of bound book. Cormac Industries, Inc. calls the unit the Book-Printer. It weighs only 20 lb and can be put on a desk. It is said to produce margin-to-margin copies of pages up to 11 x 17 in. The unit is triangular in shape so that only the page to be printed comes in contact with the photosensitive paper and the lights. There is no fuss with pressing pages under glass. With this light exposure unit you will need a processing unit, also available from Cormac.

Time Savers

Many times, the smaller pieces of equipment that can be used in

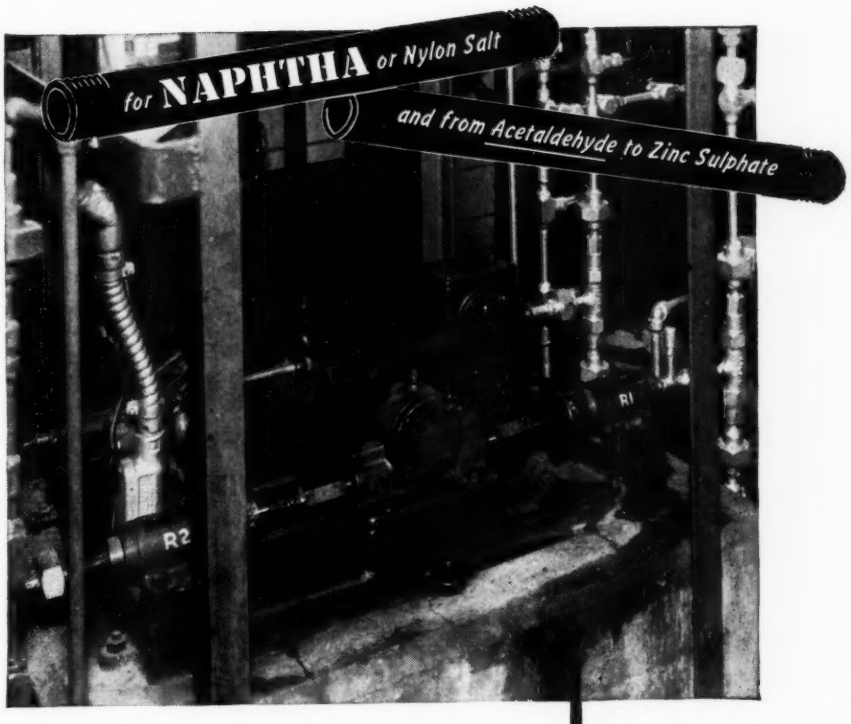
either field or office, such as special slide rules, devices for linear or angular measurement, and pocket calculators, save time and tempers. Arthur F. Eckel, now president of Lithocalculator Co., is designing a new series of improved slide rules, the first of which is a simplified circular rule on which computations are made by dialing in the numbers with the cursor. Division lines are on white faced metal, precision spaced. On the back are decitrigonometric scales.

A consulting engineer in Louisiana has designed a hydraulic slide rule for determining rate of flow, pressure, diameter, or friction factor of products pipelines based on the Williams and Hazen formula. Adapted for the specific gravity of gasoline, the rule incorporates a viscosity factor so that the friction factor can be changed to correspond to the kinematic viscosity of the product being pumped. Pickett and Eckel, Inc. is producing it in alloy metal.

For measuring longitudinal as well as angular dimensions without wasting time counting fine graduations, George Scherr Co. offers a jointed, stainless steel two foot rule which also serves as a protractor. It has a scale of chords engraved on one side from 0 to 120 in half degrees and is graduated in 1/8, 1/16, 1/32, and 1/64 in. With the aid of a divider and the dot on each blade any angle can be set or determined.

Hand Size Calculator

Wherever you go, in the office or in the field, you have the advantage of a desk calculator with use of the Curta, a new "hand size" calculating machine. This is a universal calculator; it will multiply, divide, add, subtract, extract square root, cube, factors, and percentages with the speed and accuracy of a desk calculator. Weighing only eight ounces, it has eight places in the key board with 11 places in the answering dial. Superior Business Equipment Co. makes this. ▲▲



HILLS-McCANNA
"U" Type metering / proportioning PUMPS

give TROUBLE-FREE PERFORMANCE ON TROUBLESOME FLUIDS

Built to serve dependably in an industry that is *on the move,* the Hills-McCanna "U" Pump is daily finding new services to add to a diverse group of hundreds of different types of metering and proportioning jobs. But assurance of trouble-free performance through a wide range of problem fluids is only one of several versatile features offered by the "U" Pump.

One, two, three and four feed assemblies, mounted on a common base, are available in a range of capacities from 0.10 to 24.0 gph per feed. Operating pressures are from 125 psi to 5000 psi. Variable speed drive or a choice of 30, 40, 50 and 70 strokes per minute (with stroke length adjustment from 0 to maximum) provide efficient *controlled* pumping . . . reliability and accuracy that has made the "U" Pump the *preferred* pump for research, pilot plant and production uses.

Write for Bulletin UP-54, outlining "U" Pump service . . . recommendations for over 325 applications. And ask about other Hills-McCanna metering and proportioning pumps. HILLS-McCANNA CO., 2446 W. Nelson St., Chicago 18, Ill.

HILLS-McCANNA
metering and proportioning pumps

Also Manufacturers of:
SAUNDERS TYPE DIAPHRAGM VALVES
FORCE FEED LUBRICATORS • MAGNESIUM ALLOY SAND CASTINGS

Jerguson

TRUSCALE

Remote Reading Gages

Available with Explosion Proof Illuminators.

Full 180° Visibility
Accuracy to ½ of 1%

You get full 180° visibility with the new Jerguson Truscale Gages with the Convex Scale. Scale markings are directly on the convex face and the indicator goes clear around the convex surface. You can bring your liquid level down to the control room floor, or other remote point . . . and can see it from anywhere in the room . . . can check a whole line-up of Truscales with one look from any point.

Truscale is really accurate too . . . sensitive to ½ of 1% of scale reading. Simple trouble-free construction. Available with signal horns, lights and up to six repeaters for other auxiliary points.

New design boiler water gage gives maximum visibility

Jerguson's unique offset single piece gage chamber gives you more inches of visibility with no blind spots. Special valve with horizontal loop keeps the strain off the gage under varying conditions of expansion and contraction.

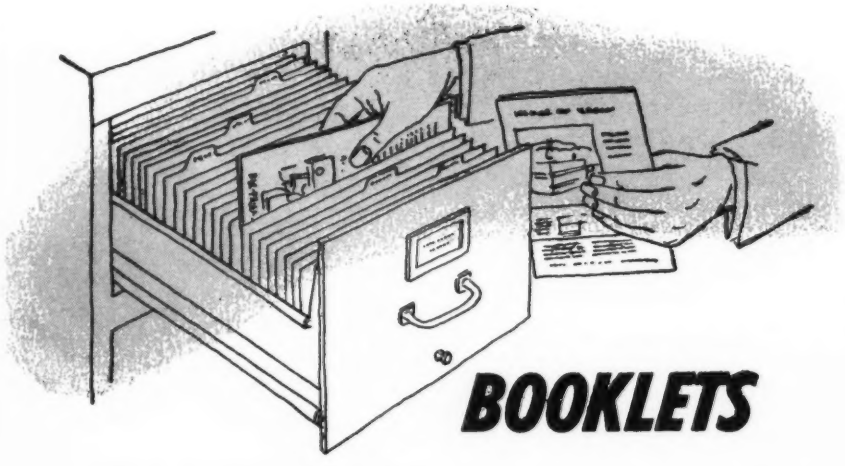
Send for complete data on Jerguson Convex Scale Truscales . . . and Boiler Water Gages.

JERGUSON

Gages and Valves for the Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY
100 Fellsway, Somerville 45, Mass.

Offices in Major Cities
Bailey Meters & Controls, Ltd., London, Eng.
Controle Bailey, Paris, France



BOOKLETS

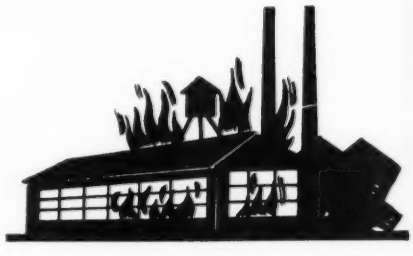
For copies of these booklets for your files, write on company letterhead directly to address given. For immediate service, telegraph and request Air Mail Delivery.

"INSTRUMENTATION AND CONTROL FOR WATER FILTRATION PLANTS," 16-page reprint, contains photographs and diagrams of Builders' complete line of instrumentation equipment. *Builders-Providence, Inc., 345 Harris Ave., Providence, R.I.*

"MODERN FILTRATION," 16-page booklet, includes basic information on advantages of porous bronze as a filtering medium and engineering data on bronze filters already in production for aircraft, chemical, petroleum, and other industrial applications. *Permanent Filter Corp., 1800 W. Washington Blvd., Los Angeles, Calif.*

EXPANDZORBER, a complete line of flexible pipe connections used to solve vibration and expansion control problems in industrial and process piping, is described in 12-page catalog EZ-55. It gives pressure and temperature ranges of application, dimensions and specifications, and special-purpose types available. *T. R. Finn & Co., Inc., Industrial Div., Hawthorne, N.J.*

A NEW LINE OF PHOTOGRAMMETRIC stereoscopes and rangefinders are described in two-page data sheet. It includes both observation and map plotting instruments, ground range-finding equipment, and mirror-type stereoscope with accessory binoculars for viewing aerial photographs in three dimension. *Hugo Meyer & Co., Inc., 39 W. 60th St., New York 23, N.Y.*



"RETARDING THE SPREAD OF FIRES IN BUILDINGS," eight-page bulletin, outlines a program of planned fire protection stressing the importance of venting for expelling the fumes and delaying heat build-up. Elevation drawings of the Pyrodome and Pyrovent roof venting units are given. *Wasco Products, Inc., Cambridge, Mass.*

NOMOGRAPHS—A new method for producing permanent nomographs on abrasion-resistant anodized aluminum plates, using conventional photographic techniques, is detailed in this booklet. *Metalphoto Corp., 2903 E. 79th St., Cleveland 4, Ohio.*

HIGH PRESSURE DIFFUSERS—Bulletin K-33, 48 pages, makes available

"85% MAGNESIA INSULATION MANUAL," 80 pages, is a revision of the 1949 edition. It offers new engineering and product data, an explanation of chemical and physical properties of 85% magnesia, new conductivity, density, and fire-resistance data. Heat loss tables have been recalculated to apply to the new thicknesses in which 85% magnesia and diatomaceous silica pipe insulation are now manufactured. Nominal and actual thicknesses are given for pipe sizes up to 24 in. Data are applicable to hot piping and equipment for industrial, commercial, institutional, and other users of heat insulation. *Magnesia Insulation Manufacturers Association, 1317 F St., N. W., Washington 4, D.C.*

AFTER-COOLER FOR NEW DETROIT FOUNDRY

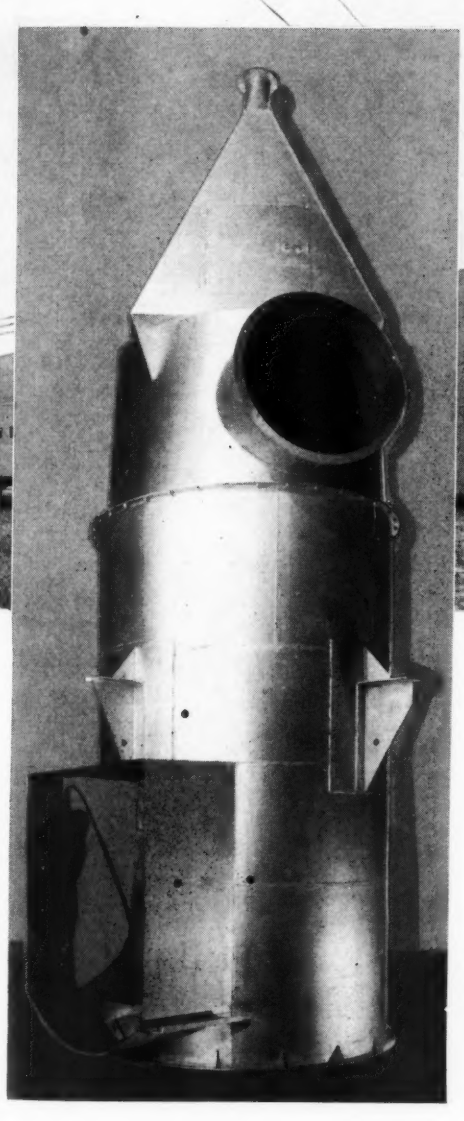


Photo at left shows one of two cooling chambers, integral components of vortex type dust collectors. Special design by Grindle Corporation eliminates dust, fumes, general smoke nuisance from expanded cupolas and stacks of major Detroit automobile manufacturer.

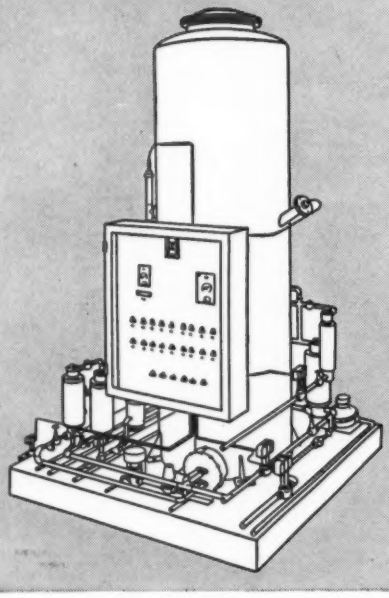
After-cooler pictured above is typical of heavy *precision* weldments manufactured by Foster. New building has heavy duty over head crane facilities; houses new equipment for shearing, burning, bending, braking, forming, annealing, sand-blasting.

Raw materials from nearby Gary-Chicago mills; deliveries by motor freight, railroads, barges via Illinois and St. Lawrence Waterways.

Tho costs are moderate, fine quality and agreed delivery are sole standard at Fosters.

THE **foster** COMPANY ST. JOSEPH, MICHIGAN

ILLCO-WAY
ionXchange



NEW AUTOMATIC "PACKAGE" UNIT FOR LOW-MAKE-UP POWER PLANTS

Now, at reasonable cost, power plants with moderate make-up requirements can take advantage of the many benefits offered by ionXchange — by installing the compact and preassembled unit illustrated above. This is a complete Mixed-Bed De-Ionizer with all necessary indicators and automatic controls, including push-button regeneration, ready for hook-up in your water supply line. *Please write for details.*

ILLINOIS WATER TREATMENT CO.
ionXchange

ILLCO-WAY
833 CEDAR ST.
ROCKFORD,
ILLINOIS

NEW YORK OFFICE: 141 E. 44TH ST. NEW YORK 17, N. Y.
CANADIAN DIST. PUMPS & SOFTENERS, LTD. LONDON, ONT.

BOOKLETS —Starts on page 76

in one manual current data on high pressure air transmission. Where this technique may be used to advantage, engineering considerations, single and dual duct designs, and typical layouts are covered. *Connor Engineering Corp., 500 5th Ave., N.Y. 36, N.Y.*

AIR CONDITIONING — Independent consulting engineers' views on air conditioning of office buildings, banks, motels, and department stores are presented in "1954 Architectural File Folder." It contains reports on air conditioning installations in specific types of buildings. *F. R. Zumbro, Du Pont Co., 6529 Nemours Bldg., Wilmington 98, Del.*

PUMPS AND COMPRESSORS—Six-page catalog 603 pictures and briefly describes the Pennsylvania line of air and gas compressors, dry vacuum pumps, check valves, aftercoolers, and centrifugal pumps for handling water and aqueous solutions including boiler feed water. *Pennsylvania Pump & Compressor Co., Easton, Pa.*

VALVES — This 20-page condensed refrigeration valve catalog is an enlarged version of the 1954 catalog. It shows new products issued by A-P in '54 and early '55 along with the standard valves, filters, and dryers. Selection data, charts, and capacity tables on each product are designed to assist in selection of proper sizes, types, and capacities. *A-P Controls Corp., 2450 N. 32nd St., Milwaukee, Wis.*

"RILEY REFUSE FUEL BURNING EQUIPMENT," eight-page bulletin, describes the pneumatic refuse fuel distributor, proportioner, feeder, and a variety of grate designs to meet various operating conditions. Units are designed to burn refuse fuels alone or in combination with coal, oil, or gas. *Riley Stoker Corp., Worcester, Mass.*

FOR IMMEDIATE SERVICE
If you would like immediate service, wire to address given and request Air Mail Delivery.

UNIT COOLERS — Full physical specifications and complete application data on angle-air unit coolers are presented in bulletin 109-55. Ease of installation and service-free maintenance are discussed. *Tenney Engineering, Inc., 1090 Springfield Rd., Union, N.J.*

"ELECTRIC WELDED STEEL PIPE," eight-page bulletin PRD 3-55, gives

ERNST
SIGHT FLOW INDICATORS
"See What Goes On Inside"
For insertion into pipe
FOR EVERY APPLICATION
BRONZE, IRON, STEEL, STAINLESS STEEL

FIG. 29
Cylinder with Impeller

FIG. 17-28
Cylinder

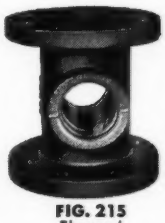


FIG. 215
Flanged

FIG. E-57
Double Window

FIG. 212
Visibility Welding Neck or Screw

FIG. E-811
Flapper

FIG. E-1810
Rotating Wheel Type

All sizes up to 6" Send for Catalog

ERNST WATER COLUMN & GAGE CO.
LIVINGSTON, N. J.

a bird's eye view of ALCO's 'pipe production line,' geared to turn out 3000 tons of pipe monthly. Recent installations of welded steel pipe are shown in progress photos and key features of the pipe are listed in table form. *ALCO Products, Inc., Schenectady 5, N.Y.*

"MODEL C-3 'ELECTRIFUGAL' PUMPS," six-page bulletin 52B6083C, describes units available in capacities to 2500 gpm, heads to 400 ft, for temperatures to 250 F. Types include those having a casing with removable suction cover and those having a casing with suction and discharge nozzles in one piece. *Allis-Chalmers Mfg. Co., 1140 S. 70th St., Milwaukee, Wis.*

"TOP RUNNING DOUBLE GIRDER CRANES," 20-page bulletin T202, covers both double and single girder cranes, gives detailed dimension sheets for each type, and presents electrical information of special value in crane installation and use. *Chicago Tramrail Corp., 1330 S. Kostner Ave., Chicago 23, Ill.*

"THE SILENT TREATMENT," covering vermiculite acoustical plastic and its application, contains a table of physical data, specifications, and sketches of two constructions granted 4-hr ratings. *Vermiculite Institute, 208 S. LaSalle, Chicago 4.*

consulting engineers' calendar

Date	Sponsor	Event	Location
Aug. 15-19	American Institute of Electrical Engineers	Pacific General Meeting	Butte, Mont.
Aug. 22-23	National Industrial Conference Board and Stanford Research Institute	Conference	San Francisco, Calif.
Sept. 7	American Institute of Consulting Engineers	Monthly Meeting	Engineers' Club New York, N.Y.
Sept. 12-16	American Society of Mechanical Engineers and Instrument Society of America	Exhibit and Joint Conference	Shrine Auditorium Los Angeles, Calif.
Sept. 12-16	Illuminating Engineering Society	National Technical Conference	Statler Hotel Cleveland, Ohio
Sept. 20-22	Society of Industrial Packaging and Handling Engineers	Packaging and Handling Exposition	Kingsbridge Armory New York, N. Y.
Sept. 25-28	American Institute of Chemical Engineers	Conference	Lake Placid Club Lake Placid, N.Y.
Sept. 25-28	American Society of Mechanical Engineers	Petroleum-Mechanical Conference	Roosevelt Hotel New Orleans, La.
Sept. 26-30	Atomic Industrial Forum	Fall Meeting and Trade Fair	Sheraton-Park Hotel Washington, D.C.
Oct. 3-5	National Electronics Conference, Inc.	Conference	Hotel Sherman Chicago, Ill.
Oct. 3-7	American Institute of Electrical Engineers	Fall General Meeting	Morrison Hotel Chicago, Ill.
Oct. 5	American Institute of Consulting Engineers	Monthly Meeting	Engineers' Club New York, N.Y.
Oct. 12-15	American Chemical Society	8th National Chemical Exposition	Coliseum Chicago, Ill.
Oct. 13	American Institute of Chemical Engineers	Symposia	Hotel Statler New York, N.Y.
Oct. 19-20	American Society of Mechanical Engineers and American Institute of Mining and Metallurgical Engineers	Joint Fuels Conference	Neil House Columbus, Ohio
Oct. 24-26	American Standards Association	6th National Conference	Sheraton Park Hotel Washington, D.C.

PROFESSIONAL LISTINGS

MICHAEL BAKER, JR., INC.
Consulting Engineers
Civil Engineers, Planners, Surveyors; Airports, Highways, Water & Sewerage Design; Aerial Topographic Maps; Dams; Irrigation; Reports; All types surveys.
Home Office: Rochester, Pa.; Branch Offices: Jackson, Miss., Harrisburg, Pa.

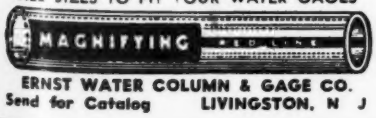
Capitol Engineering Corporation
Engineers — Construction — Management
Design and Surveys — Roads and Streets
Sewage Systems — Water Works
Planning — Airports
Bridges — Turnpikes — Dams
EXECUTIVE OFFICES
DILLSBURG, PENNSYLVANIA
Washington, D. C. — Pittsburgh, Pa.
Dallas, Texas — Paris, France

DE LEUW, CATHER & COMPANY
CONSULTING ENGINEERS
Transportation, Public Transit and Traffic Problems
Industrial Plants — Grade Separations
Railroads — Expressways
Subways — Tunnels
Power Plants — Municipal Works
150 N. Wacker Drive, Chicago 6, Ill.
79 McAllister Street, San Francisco 2, Cal.

PROFESSIONAL LISTINGS
Your professional card listing specialized services will be seen by other consultants throughout the country.
Rates — Payable in advance
6 listings (min. order) $ 60.00
12 consecutive listings $100.00
For further information write:
CONSULTING ENGINEER
227 Wayne St. St. Joseph, Mich.

PETER F. LOFTUS CORPORATION
Design and Consulting Engineers
Electrical • Mechanical • Structural
Civil • Thermodynamic • Architectural
First National Bank Building
Pittsburgh 22, Pennsylvania

SEELYE STEVENSON VALUE & KNECHT
CONSULTING ENGINEERS
Richard E. Dougherty, Consultant
Manufacturing Plants
Heavy Engineering
Structural Mechanical Electrical
101 Park Ave. New York 17, N. Y.

GAGE GLASSES AND
High Pressure Rubber Gaskets
ALL SIZES TO FIT YOUR WATER GAGES


ERNST WATER COLUMN & GAGE CO.
Send for Catalog — LIVINGSTON, N J

Abrams Aerial Survey
Corporation
Planimetric and Topographic Maps from Aerial Photography
Complete Facilities
Write for Literature
600 Shiawassee — Lansing, Mich.

THE HINCHMAN CORPORATION
ENGINEERS
CORROSION CONTROL — Surveys, Reports, Cathodic Protection Designs & Specifications
UNDERGROUND UTILITIES — Location, Mapping, Leakage Surveys
ELECTRICAL GROUNDING SYSTEMS and Surveys
Francis Palms Bldg. — Detroit 1, Mich.

How to analyze feedback control systems—

This book demonstrates the essential techniques for determining response of linear control systems, with special emphasis on the Root-locus Method invented and developed by the author. This method is particularly useful for complicated systems or those requiring complete solution.

The type of problem covered ranges from the change of speed in a motor to a suddenly applied voltage up to the inter-action of the roll and yaw motions of an airplane. In addition, each solution establishes a concept which permits a simpler technique to be applied to the next more complicated problem. The main feature of the author's presentation is that the physical picture of a solution is developed first with the mathematics introduced later as needed.

Just Published

CONTROL-SYSTEM DYNAMICS

By Walter R. Evans

Systems Group Leader
Electromechanical Engineering Department
North-American Aviation, Inc.

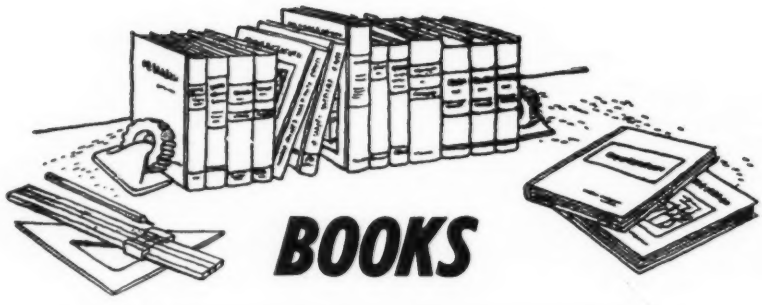
282 pages, 6 x 9,
282 illustrations, $7.00

The author's Root-locus Method is a new approach to the analysis of linear systems which permits the roots of the characteristic equation to be determined in a simple sketch which shows the effect of the open loop function and the loop gain. The roots in turn permit the transient response as well as the frequency response to be plotted. Engineers using the method have found that the plot itself is usually sufficient to describe the behavior of the system, with plotting the transients unnecessary. The effects of several loops in succession can be visualized by a series of root-locus plots.

Covers —
- **–field analogy of root-locus plots**
- **–correlation of block diagrams**
- **–rule of Cramer's rule for determinants**
- **–transfer matrix concept for coupled systems**
- **–graphical treatment of noise theory**
- **–Thevenin's Theorem applied to electro-mechanical systems**

The opening sections of the book describe the overall problem and the characteristics of typical components; the final sections discuss the treatment of arbitrary inputs and simple nonlinear systems. **Throughout the author emphasizes physical understanding** of the problems as contrasted with memorizing a routine for solving particular problems.

Mail order to
CONSULTING ENGINEER
227 Wayne Street **St. Joseph, Mich.**



BOOKS

TO ORDER BOOKS

As a readers' service, CONSULTING ENGINEER will order reviewed books or any other technical volumes you need. In ordering books, give title, author, and publisher and enclose check. We will also suggest titles of books on any technical subject and order for you at regular publishers' prices.

MATERIALS OF CONSTRUCTION, by M. O. Withey and G. W. Washa; John Wiley and Sons, Inc.; 887 pp; $9.00.

Reviewed by Robert K. Posey
Skidmore, Owings & Merrill

The Preface comments that the authors, Professors M. O. Withey and G. W. Washa of the University of Wisconsin, have aimed to present a book that serves both as a text book and as a reference book. To this extent it can be said to be an up-to-date rewriting of the widely used older book *The Materials of Construction* by the late Dean J. B. Johnson.

In examining the book, I find myself at odds with the title. "Materials of Construction" implies an all inclusive discussion whereas the actual scope is limited to the basic study of wood, stone, structural clay products, cement, concrete, and structural metals. Since the first two, wood and stone, are primarily decorative materials in present day major construction use, it would seem to be misplacing emphasis to devote 158 pages to these materials.

Appearance of decoration or ornamentation is of importance. The graining of wood, the marking of marble and other stones, and the successful finishing of their outer skin has received only limited comment in the book. Brick and other structural clay products are approaching the classification of wood and stone insofar as ornamental use is concerned. Concrete and metal are used both as structural and finishing materials. A better balance in emphasis would have made for wider use of the book by architects and would have presented a text book of broader understanding.

The book does present accurate records of sources of supply and manufacture, and gives carefully selected data of the physical properties of the materials discussed. It has a large number of references to additional sources of information and is clearly illustrated. Photographs and figures show the latest testing machines and methods. For those who are interested primarily in mechanics, the book is a fine source of theoretical inspiration and reference.

There are eight chapters on cement and the derivatives, plaster, mortar, and concrete. They are accurate and complete within the scope of the book. The consulting engineer will not find a ready written specification in these chapters, but he will find the essential foundation upon which to build his own standards.

The mechanics of metals are dwelt upon accurately and concisely, in even greater volume. Iron, steel, and non-ferrous metals, following a pace set by their use in the automotive, marine, and aeronautical fields, are rapidly gaining importance in the building industry. This is true in an architectural, as well as mechanical and structural sense.

The student of engineering will find *Materials of Construction* to be a fascinating story of the strength of materials. Research and testing engineers will find it to be a sound background upon which to build effective exploration.

•

ENGINEERING CONTRACTS AND SPECIFICATIONS (third edition), by Robert W. Abbett; John Wiley & Sons, Inc.; 429 pp.; $6.00.

Reviewed by Hugh B. Clayton
Sargeant & Lundy, Engineers

The author presents, in this expanded edition, a very orderly and complete review of the laws and bidding procedures applicable to construction contracts. The reader will be happy to find that the book

is broad in subject matter, not being limited solely to legal issues, but covering also related matters such as insurance, bonds, contracts for engineering services, and an evaluation of various contract bases. A very useful and relatively detailed section of the book deals with bidding procedures which is a subject often slighted in books written more exclusively from the legal viewpoint.

Construction is the primary interest of the discussion on contracts, and little is included to cover purchasing of mechanical and electrical equipment where construction is not involved. This is also true of that part of the volume covering specifications; here again the material given is mainly structural or architectural in character. A closely related subject which is not covered is that of escalation which would seem pertinent to this work.

The four chapters covering specifications set forth the principles and requirements to be followed in order to write a logical, orderly, and comprehensive specification. The approach is definitely that of an experienced engineer who has dealt with these problems in actual practice and very ably shows how many difficulties can be avoided if good practice is followed in writing the specification.

Stress is laid on the use of correct and concise wording to avoid conflicting requirements in specifications, causing misunderstanding in interpretation, in order to safeguard the owner's interests but at the same time be fair to the contractor. The principles outlined should be of considerable benefit to owner, engineer, architect, and contractor alike.

There is often a danger that persons not competent in legal matters may tend to accept the conclusions of a work such as this, rather than consult a lawyer when necessary. An intelligible, explanatory presentation of legal points, as opposed to the case history method which fulfills another purpose, may appear to be more complete than it is, since slightly altered circumstances or individual state laws make it inadvisable to use such a book as more than a guide.

All in all, this is a well organized and comprehensive text, and can be highly recommended as a background for young engineers and architects, and as a very useful reference book for all.

ALSO AVAILABLE

PROFIT MANAGEMENT AND CONTROL, by Fred V. Gardner; McGraw-Hill Book Co., Inc.; 300 pp; $6.00.

Dealing with practical application of profitgraphs and the break-even point, this book tells how to coordinate capitalgraphs and profitgraphs and how to tie them into the fundamental balance sheet and profit and loss statements. Material is supported by illustrations based on the author's experience as officer, director, and consultant for various companies.

•

THE PREPARATION OF ENGINEERING REPORTS, by Thomas R. Agg and Walter L. Foster, McGraw-Hill Book Co., Inc.; 192 pp; $3.75.

Deals with the necessary elements of each type of report, showing where they go in the report, and how they should be handled in form and treatment. It presents methods of preparing graphs, maps, and flow sheets, gives pointers on style, and lists correct technical abbreviations.

•

APPLIED SOLAR ENERGY RESEARCH, edited by E. J. Burda; Stanford Research Institute; 300 pp; $5.00 ($4.00 for paper binding).

This is a directory of world activities related to solar energy utilization, by country. It includes a selective bibliography of technical and scientific publications with title and address of the research group, names of principal researchers, and brief description of the solar research program.

•

GOVERNMENT PUBLICATIONS. The following books, of particular interest to consulting engineers, are available from Superintendent of Documents, Washington 25, D. C.: *Nuclear Power Reactors, Vol. 2,* 15¢; *Organized Industrial Districts,* 65¢; *Brazilian Technical Studies,* No. FO 1.2:B73/2, $3.25.

FILMS

"A DAWN'S EARLY LIGHT," Westinghouse Electric Corp., sound and color, 30 minutes.

This film tells in story form about the building of the USS Nautilus. It shows actual scenes taken during construction by Westinghouse in both Idaho and Pittsburgh. It also points out peaceful uses of atomic energy.

•

"COMPRESSED AIR POWER," Compressed Air and Gas Institute, sound and color, 16 mm, 17 minutes. This is the story of how air is compressed, the machines employed, and the basic principles of utilization.

•

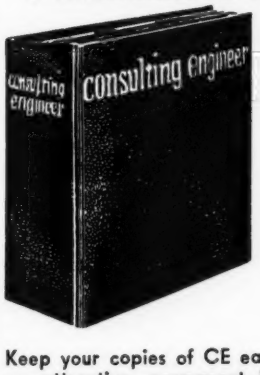
"SELECTED MOTION PICTURES 1954-55, Association Films, Inc. This is a complete catalog of 16 mm sound pictures, some in color. It is separated into four sections: Free Films, Teaching Film Custodians Subjects, Educational Films, and Entertainment, and is indexed by title.

ARTICLE REPRINTS

A limited number of reprints listed below are available free of charge to our readers. If you need an extra copy please write, using your company letterhead, to: Reader Service Dept., CONSULTING ENGINEER, 227 Wayne St., St. Joseph, Mich.

"Solving Ground Water Problems"
"What to do when your clients need Air Pollution Control"
"What It Takes To Consult In Automation"
"Electric Spark Machining"
"New Techniques Cut Drafting Costs"
"Design Data For Expansion Joints"
"Engineering A Site Study"
"Three-D Scale Models"
"What's New in Blasting?"
"Profitability Calculations Simplified"
"Gage Glass to TV Tube"
"Lift Slab Construction"
"Selecting Automatic Controls for Water Conditioning Equipment"
"High Temperature Water and its Applications"
"Planning for Heliports"
"Applications of Coal Microscopy"
"Why We Oppose Turn-Key Projects"
"Engineered Timber Construction"
"High-Rate Composting"
"Passenger Conveyors Are Here"
"Compacting Sandy Subsoil"
"The Engineer's Status In Product Design Organizations"
"Excellence in Design"
"How to Hire (and Hold) Engineers"

Permanent Binders



$3.00

Holds 12 copies of CONSULTING ENGINEER

Keep your copies of CE easily available in an attractive, permanent binder. Suitable for home or office library. Binder holds 12 copies, each fixed in place with a wire fastener. No punching or special binding equipment is required. These binders have CONSULTING ENGINEER stamped in gold on the front cover and on the spine.

Copies of most issues still available to complete your file.

order from

CONSULTING ENGINEER
227 Wayne St. St. Joseph, Mich.

consulting engineer

ADVERTISERS' INDEX

Anaconda Wire & Cable Company 23

Babcock & Wilcox Company 17
Beckman, Inc., Arnold O. 22
Blackmer Pump Company 66
Bruning Company, Inc., Charles 3-11
Buffalo Forge Company 72
Byers Company, A. M. 73
Byron Jackson Company 71

Cleaver-Brooks Company 21
Cochrane Corporation ..... Fourth Cover
Combustion Enginering, Inc. 67

Dearborn Chemical Company 35
Detroit Stoker Company 32

Ernst Water Column & Gage Company 78

Fairmont Coal Bureau 70
Foster Co., The 77

Hays Corporation, The ..... Second Cover
Hills-McCanna Company 75

Illinois Water Treatment Company 78
Irving Subway Grating Company 24
I-T-E Circuit Breaker Company, Switchgear Division 7

Jeffrey Manufacturing Company 69
Jerguson Gage & Valve Company 76
Johnston Pump Company 28

Kewanee-Ross Corporation 27

Mahon Company, The R. C. 9

Newport News Shipbuilding & Dry Dock Company 65

Patterson-Kelley Company, Inc. 25
Powell Company, The William 4
Prat-Daniel Corporation, Power Division 10
Prat-Daniel Corporation, Thermobloc Division 74

Reliance Electric & Engineering Company 29
Richardson Scale Company 15

Standard Steel Spring Division 8

Thermix Corporation, The 10

U. S. Steel Corporation 19

Warren Webster & Company ..... Third Cover
Weinman Pump Manufacturing Company 68

Yarnall-Waring Company ..... 12 & 13

Sales Representatives

New York, N. Y.

Theodore E. Gordon
10 Commerce Court
Newark, N. J.
Market 3-0560

Philadelphia, Pennsylvania

David L. McKechnie
816 Lancaster Avenue
Villanova, Pennsylvania
Lawrence 5-4692

Cleveland, Ohio

O. DeWitt Young
3304 Avalon Road
Shaker Heights, Ohio
Wyoming 1-4841

Chicago, Illinois

Ernest R. Gauley
360 N. Michigan, Rm. 614
Dearborn 2-3519

Los Angeles, California

Justin Hannon
4068 Crenshaw Boulevard
Axminister 2-9501

Sales Manager — O. D. Young